



THE FLAMETHROWER

CHRIS McNAB





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INTRODUCTION

Although any history of flamethrowers must work its way through their technological and tactical development, we must on no account sanitize what these weapons do. All weapons are, by their very nature, ghastly in purpose, but there is something uniquely awful and inhumane about the flamethrower. Fire is popularly and quite logically held as one of the worst ways to die. It is not quick, the victim taking long seconds and even minutes to succumb, as flesh, nerve, muscle and eventually organs are charred to destruction. Those who have observed such deaths give chilling accounts of the animal-like howls of the dying, bellows of such extreme agony that they haunt a lifetime of memories. The bodies of those hit by the super-hot jet of flame are progressively crumbled to ash and cinder, the final shrunken corpse scarcely resembling that of a human being. That intelligent human beings have turned their minds to developing instruments specifically to achieve this goal, represents another tragic failure in society.

US combat engineers use a flamethrower to burn away brush from alongside a river in Iraq during November 2007, eliminating hiding spots for improvised explosive devices and ambushers. (Cody Images)



Reflecting on the sheer horror of the flamethrower, however, is not ghoulish sensationalism. The terror of the flamethrower is actually at the heart of its tactical *raison d'être*, and also of its historical evolution. Flamethrowers deliver a unique form of trauma, both physical and psychological, and the nature of this trauma was a key factor in why they had battlefield value. For as much as they were influenced by destruction, they were also influenced by fear. Furthermore, the fact that flamethrowers reached their apogee during World War II – a ‘total war’ in which the gloves of humanity truly came off – is no coincidence, nor is the fact that in the more politically sensitive Cold War, their use progressively faded away. In essence, the flamethrower’s story is the steady journey towards being unacceptable.

Yet while they flourished in the arsenals of the world’s armies, flamethrowers offered undoubted power. Saturate almost any strongpoint with burning fuel and even the hardest bunker, tunnel or emplacement would likely be destroyed. Even if the physical structure somehow remained resistant, the occupants would often die of suffocation, as the burning fuel greedily fed on all the available oxygen around them. For such reasons, flamethrowers integrated themselves into the assault tactics of two world wars, from the trench lines at Verdun in 1916 through to the flame-blackened landscape of Iwo Jima in 1945.

This book narrows its focus principally on man-portable flamethrowers and their use in the 20th century, particularly during the two world wars. Mechanized flamethrowers are in many ways a subject unto themselves, as the weapon has to be discussed in context of the capabilities of the vehicle. Our narrative here is as much a human one as it is technological. As we shall see, flamethrower operators are rarely thankful for the weapon they carry. Lumbering conspicuously around a bullet-crackling battlefield with a tank of flammable fluid on your back requires either iron nerves or a brutish lack of imagination. The flamethrower operator often had a short lifespan, both reviled and respected by the enemy with whom he was forced to engage at the closest of ranges. For this reason, infantry squads had to integrate flamethrower crews into broader supportive tactics to ensure their survival, a situation we shall study in depth in this book.

A German anti-partisan formation makes its way through thick woodland in Belarus in 1942. One of their team carries a Flammenwerfer 35; the compressed nitrogen container is clearly visible by the side of the large fuel tank. (Nik Cornish at www.stavka.org.uk)



Although this book's concentration on 20th-century flamethrowers gives technological clarity, weaponized flame has a long and insidious history. From the moment prehistoric humans generated fire, it can't have taken long to realize that it could be harnessed for destruction, if only in the form of a blazing torch used for defending against or hunting animals. The tactical use of fire is recorded in the *Book of Judges* in the Bible, when Sampson set fire to the tails of 300 foxes in order to destroy the cornfields, vineyards and olive groves of the Philistines. The Carthaginian warrior Hannibal created panic among the Romans at Casilinum in 200 BC by similar means, this time a hoard of frantic oxen with flaming faggots tied between their horns.

Fiery animals must certainly have generated 'shock and awe', but there were very obvious issues with controllability (the ethics of the 'weapons' were less likely to have been discussed). So we witness technologically thoughtful armies investing in more precision means of delivering fire on the enemy. Flaming arrows were a globally popular option. By dipping the tip of an arrow in an incendiary substance, then igniting and launching it, it was possible to drop flame onto defined targets at a distance of several hundred metres. Flaming arrow technology was used by both the Chinese and the Greeks back in the 4th century BC, prolifically by medieval European armies, and even by American Indian warriors during the 19th century. Further fiery innovations also took place in Central, South-East and East Asia. The ancient Chinese used 'fire sprinklers' – long poles with crackling incendiary substances burning at the end. In India and (during the medieval period) among Arabian armies, 'fire pots' were applied as a terror weapon, these being fragile baskets of burning pitch and oil, thrown from the back of a horse or elephant to explode on impact with the ground. Similar incendiary weapons were sent skyward from trebuchets against fortress targets in Europe during the Middle Ages. In naval warfare, fire ships were a part of warfare until the early 19th century, the burning vessels scattering enemy fleets or destroying them through spreading fire to rigging, masts and hulls.

A broader scan into the history of flame weapons reveals that the mechanical flamethrowers of the 20th century also had precedents. In the 5th century BC, for example, the Spartans created a protean flamethrower

A famous image of Greek Fire in action. The burning fluid is fired from a brass or iron projector, the means of ejection (according to the ancient sources) being a blacksmith's bellows. (*Codex Skylitzes Matritensis*)



by manufacturing a pipe from a hollowed-out tree trunk, lined with iron plating and filled with a combination of burning coals, pitch, sulphur and naphtha. By operating a bellows at one end of the tube, a jet of oily flame could be emitted with some intensity against a wooden fortress structure. Such a weapon was applied by the Spartans against a fort at Delium in 424 BC, and also by the Romans (using charcoal) in AD 107 during battle against the Dacians.

Yet the supreme fire weapon of the ancient and medieval era was undoubtedly 'Greek Fire'. Much about the composition of this material, reputedly developed by the Syrian engineer Callinicus in 7th-century Constantinople, remains a mystery. Constituent ingredients could have been nitre, sulphur, petroleum, gunpowder and quick lime. Whatever the exact mix, Greek Fire had fearsome properties, burning with angry persistence, gluing itself to whatever it hit. Apparently, it was nearly inextinguishable. Water certainly didn't do the trick; more effective retardants included sand, vinegar and even urine. The actual chemical composition of Greek Fire was only part of its destructive equation, however. It was thick enough to be launched in jets from metal nozzles, powered by hydraulic pressure generated from water pumps. Thus weaponized, Greek Fire became a dreaded tool of the medieval age, most effectively applied in naval warfare against the vulnerable wooden ships. The Byzantines used Greek Fire to great effect at battles such as Cyzicus in 673 and Constantinople in 717, decimating entire Arab fleets. Byzantine ingenuity also presciently led to man-portable anti-personnel versions – metal tubes throwing fire via a short blast of air down one end.

Greek Fire was kept in action by the Byzantines until the fall of Constantinople in 1453. By this time, gunpowder weaponry was thundering its dominance on the world's battlefields, the stand-off distance and accuracy supplied by powder and shot making flame weaponry appear crude and uncontrollable. Yet the net effects of Greek Fire were not forgotten, and various liquid fire experiments continued in the subsequent centuries. In 1702, for example, one P. Lange developed for the Prussian Army the *Schlangen-Brand-Spritze* (Serpent Fire Spray), a fire-jet device that reputedly could hurl an incendiary substance up to 37m. The French developed similar weaponry for naval use during the mid-1700s, and the American Civil War (1861–65) saw flame weapons employed during the siege of Charleston in 1863.

As we can see from this brief history, the idea of using controlled jets of flame was firmly embedded in military thinking by the beginning of the 20th century. What eluded the military engineers was a truly effective, controlled delivery method, one that could give to flame a precision utility approaching that of gunpowder weaponry. That breakthrough was soon in coming.

The world's first man-portable flamethrower? This illustration dates from around 1605, and shows a soldier using a *cheirosiphōn* ('hand-siphon') flame weapon from atop a boarding bridge. (*Codex Vaticanus Graecus*)





DEVELOPMENT

Controlling the flames

BEFORE WORLD WAR I

In 1949, Lieutenant Colonel L. McKinney of the Historical Office, Office of the Chief of the Chemical Corps, US Army, published a work entitled *Portable Flame Thrower Operations in World War II*. It is a fascinating and invaluable book, bringing together a vast array of historical research with primary and secondary material. It also charts, albeit briefly, the cause behind the development of portable flamethrower weapons by the Germans during the early 1900s:

An incident, reported as occurring during German maneuvers sometime prior to World War I, may have accounted for the decision to develop the *Flammenwerfer* [flamethrower] for tactical employment. During maneuvers a German major was told to hold a fortification at all costs. When the attackers reached the strongpoint, the Major, in desperation, turned a fire hose on them. He explained later, in the critique, that he was playing burning oil on his enemies. The idea was exploited and the ‘*Flammenwerfer*’ used during World War I was the result. (McKinney 1949: 8)

The story is evocative and entertaining, although tracking down the source proved problematic. What is certain is that during the first decade of the 20th century, Germany established a technological lead in the development of flamethrowers, and thus had a tactical lead in the looming world war.

On 25 April 1901, a Berlin mechanical engineer named Richard Fiedler secured a patent for a *Verfahren zur Erzeugung grosser Flammenmassen* (‘Method of Producing Large Masses of Flame’). In fact, Fiedler was developing a number of different designs, fuelled by his more benign experiments in producing high-pressure commercial liquid sprayers. It was



a short conceptual step from spraying paint to spraying and then igniting fuel, to produce a directable and destructive jet of fire. Tactically, Fiedler had also found a niche. Infantry assaulting enemy strongpoints had to rely on a variety of hand-deployed weapons, such as demolition charges and grenades, all of which usually required leaving cover, crossing perilous open ground and then deploying the weaponry against a wall or through an aperture.

The *Pioniere* (German combat engineers) did own an incendiary option for such assaults, the Brandröhre M.95 (Firetube M.95). This was a long sheet-metal tube (roughly 1.2m long and 125mm in diameter), filled with an incendiary compound, to which a lanyard-activated friction igniter was attached. Deployed in six-man fire-tube squads, the Brandröhre was intended to be pushed into a casemate on the end of a long pole, at which point the lanyard was pulled to ignite the compound. The result was a jet of flame about 2m long, plus lots of unhealthy smoke. Fire tubes were useful for close-up attacks, but the short flame jet plus the lack of stand-off distance for those deploying them meant they had severe limitations. It was such limitations that Fiedler was addressing. By marrying a tank of fuel with a gas-propulsion system, a jet of flame could be sent over more than 10m. Furthermore, by providing a lance delivery system, the flame could be aimed with reasonable precision, meaning that the *Pioniere* could attack small embrasures from a decent protective distance.

Fiedler needed to take his patent and fledgling designs to market. In 1905 he conducted a flamethrower demonstration for the Preussisches Ingenieur-Komitee (Prussian Engineer Committee) in Berlin, and received a favourable response, with some requests for adjustments. These he made, and the Engineer Committee was satisfied enough with the results that in 1908 it established the Pionier-Versuchs-Kompagnie (Pioneer Experimental Company) to develop a tactical framework for the new weapon. In 1909, the German forces even took the step of designating the new 'Flammenwerfer' (flamethrower) as the replacement for the crude fire tubes.

Fiedler continued to refine his flamethrower designs, aided by engineer and soldier Bernhard Reddemann. Reddemann had been experimenting with flame weapons independently, inspired by the combat applications of kerosene hand sprays by Japanese troops during trench assaults in the Russo-Japanese War (1904–05). In 1907 Reddemann performed demonstrations of flamethrowers at Fortress Posen, the devices produced from converted fire-brigade steam pumpers. The following year, he and Fiedler met, and began a fruitful collaboration that would place Germany well ahead of all other rivals in terms of flamethrower development.

A World War I-era German flamethrower team operate a large static flamethrower, the tank system being just out of view. Note the man on the left with the burning wick, to ignite the fuel. (Courtesy of Thomas Wictor)

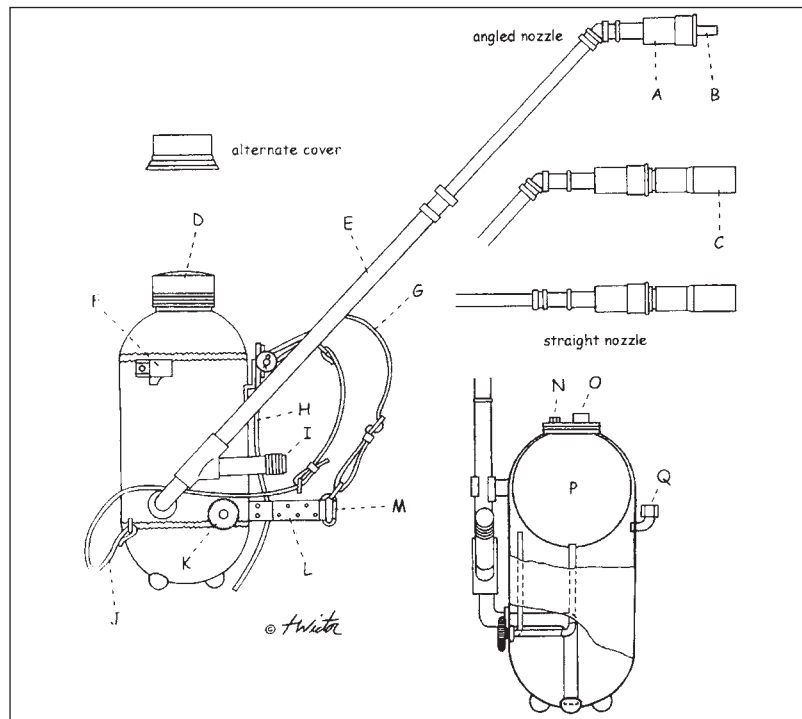
FLAMETHROWERS OF WORLD WAR I

In the summer of 1914, a flurry of shots on the streets of Sarajevo sputtered into outright global conflict. Germany's sweeping attempt to invade Western Europe, capture Paris in rapid order and then turn east to defeat a still-mobilizing Russian Army ended in failure. Instead, while the Eastern Front remained a mobile conflict, the Western Front burrowed itself into static earth, the two sides facing each other across trench lines that stretched from the North Sea to the Swiss border. Flamethrowers found a home in this new type of warfare. They were ideal devices for trench and emplacement assault, incinerating entire trench sections or bunker structures in intense blasts of oily flame. By the time World War I drew to a close in 1918, it was evident that flamethrowers had become a component in the arsenal of all combatants, although with varying degrees of commitment and priorities.

The Central Powers

The two principal German designs at the start of the war were the *kleine Flammenwerfer* (Kleif) M.1912 and the *grosse Flammenwerfer* (Grof) M.1912. As their *kleine* (small) and *grosse* (large) suffixes indicate, the two flamethrowers were different in scale, effect and employment. The Kleif M.1912 was the world's first man-portable production flamethrower. It consisted of a single tank, which contained a fuel reservoir filled with an oil/petrol mix, plus a separate chamber in the top of the tank containing pressurized carbon dioxide or nitrogen. (Note that in some instances we see the M.1912's propellant tank fitted externally to the main fuel tank,

The Kleif M.1912: (A) igniter holder; (B) lance nozzle; (C) igniter with protective cover in place; (D) threaded cover; (E) telescoping lance attached to flamethrower by swivelling universal joint; (F) clamp for holding lance during transportation; (G) leather shoulder strap; (H) steel carrying frame; (I) block valve; (J) lance strap for containing recoil; (K) oil pressurization valve; (L) steel waist support; (M) carabiner; (N) propellant-filler cap; (O) pressure gauge; (P) propellant chamber; (Q) oil-filler tube. (Text details and photo courtesy of Thomas Wictor)



although the internal configuration was far more common.) Connected to the tank via a fixed hinge was a metal lance; the nozzle of the lance, which could be either angled (for fire over trench parapets) or straight, contained a flame igniter device. The igniter could be omitted, which enabled the operator to spray unlit fuel over a target, for a comrade to then ignite explosively with an incendiary grenade. Two men operated the *Kleif* – one man wore the tank on his back via a fitted harness and also operated the lance, while the *Hilfsmann* (assistant) operated a block valve at the base of the lance to release the flow of fuel.

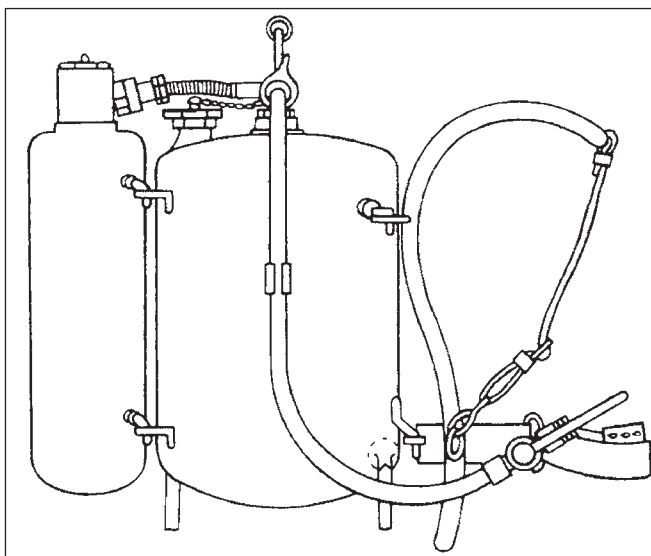
The *Kleif* M.1912 could deliver some appreciable effects. Although the total burn time was just 15 seconds, the jet of flame stretched out to 18m and beyond. However, the systems were physically fragile affairs, intolerant of the hard knocks of front-line life. Training was also inadequate – there are few things more unnerving than a poorly trained man wielding a flamethrower. For such reasons, many of the *Kleif* weapons were recalled from service by the OHL at the end of 1914, although some remained in use with line *Pionier* formations.

The *Grof* flamethrower was a far more substantial and powerful affair, manned by no fewer than five men. It had a large central fuel tank, flanked by two nitrogen propellant tanks, the whole device again feeding through to a lance via a rubber hose. The *Grof* was unwieldy – its tank measured 102x51cm and when full it weighed 75kg – but it was intended for static emplaced use, therefore its weight was not too much of an issue (except when the German troops had to move forward quickly from their positions, or effect a retreat).

Igniting the oil mixture effectively at the lance nozzle was a challenge for all flamethrower designers, not just those from Germany. Throughout World War I we see a variety of approaches. Some were highly basic – the oil might be lit by another soldier holding a burning wick. Other systems utilized a burning wick at the lance head in an igniter section; in more advanced systems, the wick was pushed forward automatically as it burnt down. The Germans developed more sophisticated versions of co-ordinating ignition with fuel release. In friction igniters, the powerful flow of oil through the igniter nozzle triggering the detonation of a percussion cap that lit the combustible materials, which then burned for approximately two minutes.

The story of German flamethrowers throughout the rest of World War I is one of rational improvement, seeking to make the weapons more user-friendly (to some degree) and also to enhance their tactical flexibility. The *Kleif* weapon went through several iterations. The *Kleif* M.1914 took

The *Kleif* M.1915 late model, distinguished from the early model by its rigid steel outflow pipe as opposed to the flexible rubber version of the early model. (Courtesy of Thomas Wictor)



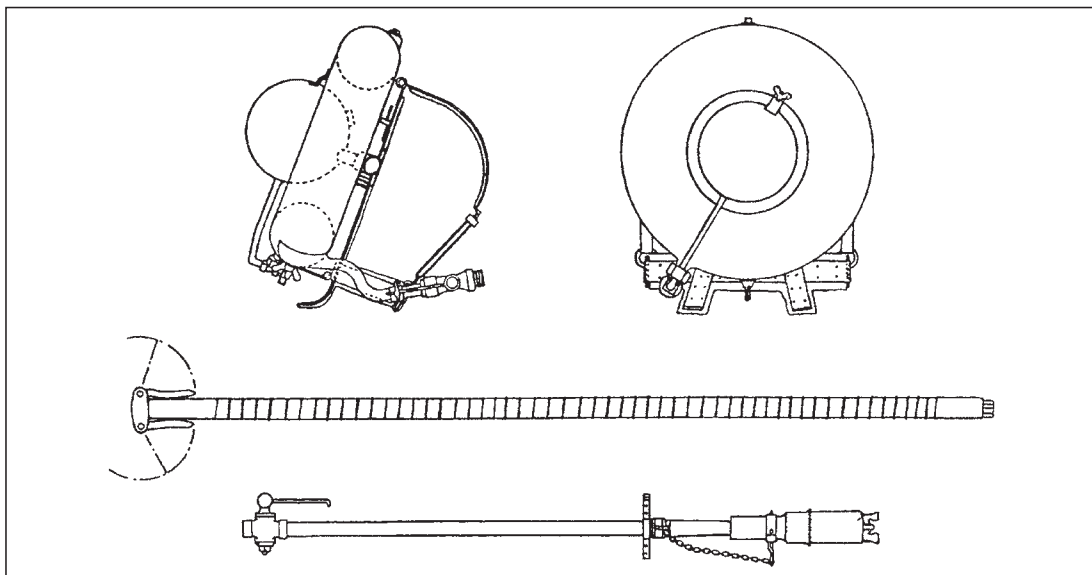
the sensible step of replacing the M.1912's rigid lance connection with a flexible rubber hose, giving the lance operator more control over aim. The new lance also featured a stopcock, so the operator could open and close the flow of fuel himself. The Kleif M.1915 took the design in a new direction. Now the propellant tank was mounted on the outside of the fuel tank, allowing an increase in fuel capacity from 16 litres to 19 litres. Progression came next with the Kleif M.1916, which as another combined oil/propellant tank design replaced the M.1914. It had an improved tank design, with a hinged filler lid, and better controls for the operators.

In turn, the M.1916 was replaced by the M.1917, with a host of incremental improvements, but in 1917 another, more radical weapon was carried onto the battlefield. This was the Wechselapparat (Wex) M.1917. The Wex was instantly recognizable by its doughnut-shaped fuel tank, with the propellant gas tank set in the centre. The capacity of the tank was low compared to the other models, just 11 litres, giving a burn duration of nine seconds (the other models had burn durations as high as 20 seconds), hence it was originally intended to be carried into the field with the team carrying two other spare tanks ready to attach to the lance. This awkward arrangement did not happen in practical terms, but as a man-portable flamethrower that could be operated by a single individual, the Wex was an important step forward.

The technology of the static flamethrowers was also advanced. The Grof M.1912 was supplanted by the Lichtgrof M.1916, which was smaller and lighter but still managed to achieve the same burn duration (45 seconds) as the previous model. Double- and triple-tank versions were introduced, extending the burn duration up to 120 seconds. Yet although the heavy flamethrowers had their role, the world of military technology owed more of a debt to the Germans' pioneering efforts in the man-portable designs.

German flamethrowers were also used by Austro-Hungarian, Bulgarian and Turkish forces. The Austro-Hungarians, however,

The Wechselapparat (Wex) M.1917, introduced into the German Army in May 1917, was a revolutionary new design that subsequently went on to influence the British 'Lifebuoy' design of World War II. (Courtesy of Thomas Wictor)



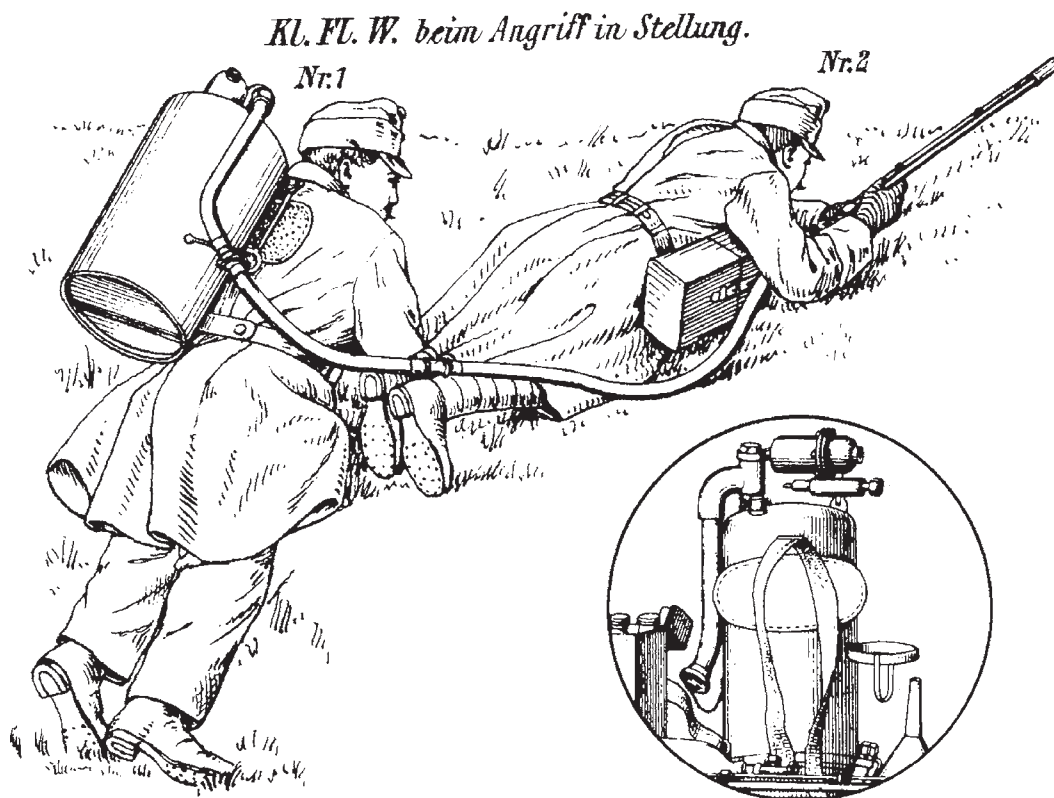
introduced some of their own models from 1915, including the three-man 50l M.15 Flammenwerfer, intended for offensive actions but (as disastrous combat experience proved) really only suitable for static defensive actions. A smaller man-portable 22-litre version and large defensive 200-litre models were also developed. Unfortunately, most of the Austro-Hungarian flamethrowers were wildly unreliable, as Thomas Wictor has pointed out:

Austro-Hungarian flamethrowers caught fire or exploded at a high rate. The large flamethrower was positioned far from troop shelters and ammunition bunkers. It was inserted deeply into the breastworks of trenches between heavy earthen weirs so that the entire area did not have to be evacuated in case of an accident. Medium and small flamethrowers were often used lying on their sides, covered in a layer of dirt.

Hoses up to 33 feet long were used with all models of flamethrower, so that the 'flame shooter' (*Flammenschütze*) could be stationed far from the oil tank. This was to prevent the shooter from spraying the oil tank if he became distracted, which could cause an explosion. (Wictor 2010: 41)

The lethal risks of operating such flamethrowers doubtless required men of special quality, but their work can't have made them popular with their surrounding and cautious comrades.

An Austro-Hungarian Kleine 22l M.15 Flammenwerfer team in position. The box held on the lance operator's hip contains spare wicks and ignition cartridges. The M.15 was Austria-Hungary's first indigenous man-portable flamethrower. (Courtesy of Thomas Wictor)



The Entente Powers

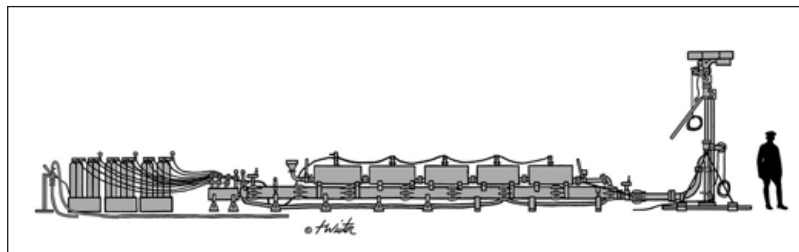
Britain's investment in flamethrower development was never as convincing as that of the Germans. After being shocked into action by German flamethrower attacks, the Ministry of Munitions' Trench Warfare Department began investing in the development of flamethrower weaponry in 1915. What was distinctive about the subsequent British efforts was that man-portable flamethrowers became largely sidelined by the focus on vast 'battery' flamethrowers, static offensive devices feeding from entire batteries of fuel tanks to deliver long-range flame attacks for extended durations. In essence, the British were trying to develop a species of flame artillery.

Various designs were trialled during 1915, including a multi-tank system by American Joseph Menchen, plus a monstrous mechanized 29-tonne flamethrower vehicle with a 45,000-litre weapon fuel capacity. Neither of these took root. Yet two systems did make it past trial stage and into active service. The first was the Vincent battery flamethrower, developed, trialled and adopted (with an order for 50 batteries) in just one month – September 1915. The device consisted of four oil/propellant tank combinations feeding to a single lance; ignition was achieved through two electrically powered spark plugs at the nozzle. It had a range of 82m and a burn duration of 50 seconds; operators had to stand behind heat shields to avoid being overcome by the intensity. Recognizing that the weapon was only suited for static emplacement, the eponymous Captain Vincent also developed a lighter (105kg) 'semi-portable' version, attached to a wheeled hand truck, but this never made active service.

The Livens Large Gallery Flame Projector was even more ambitious in scale than Vincent's offering. It was designed primarily by Lieutenant William Howard Livens of the Royal Engineers, with some assistance from his father, a civilian engineer. Served by six or seven people, the Livens was arranged as a 15m train of propellant bottles and oil tanks, the total fuel capacity being 1,090 litres. It could throw flame out to 102m for a duration of up to four minutes. Because of the scale of the thing, it was conceived that the propellant and fuel was be stored close to the front line in a specially commissioned underground mine shaft, the delivery system being pushed up to the surface by a hydraulic jack just before opening fire.

The Large Gallery Flame Projectors were used in action, most notably on the first day of the battle of the Somme (1 July 1916), but the complexity of their deployment made their contribution to the war largely insignificant. As if recognizing the logistical problems of what he had created, Livens also designed the 'Semi-Portable' flamethrower. 'Semi' was the operative word. The two-man system weighed 68kg and had to be

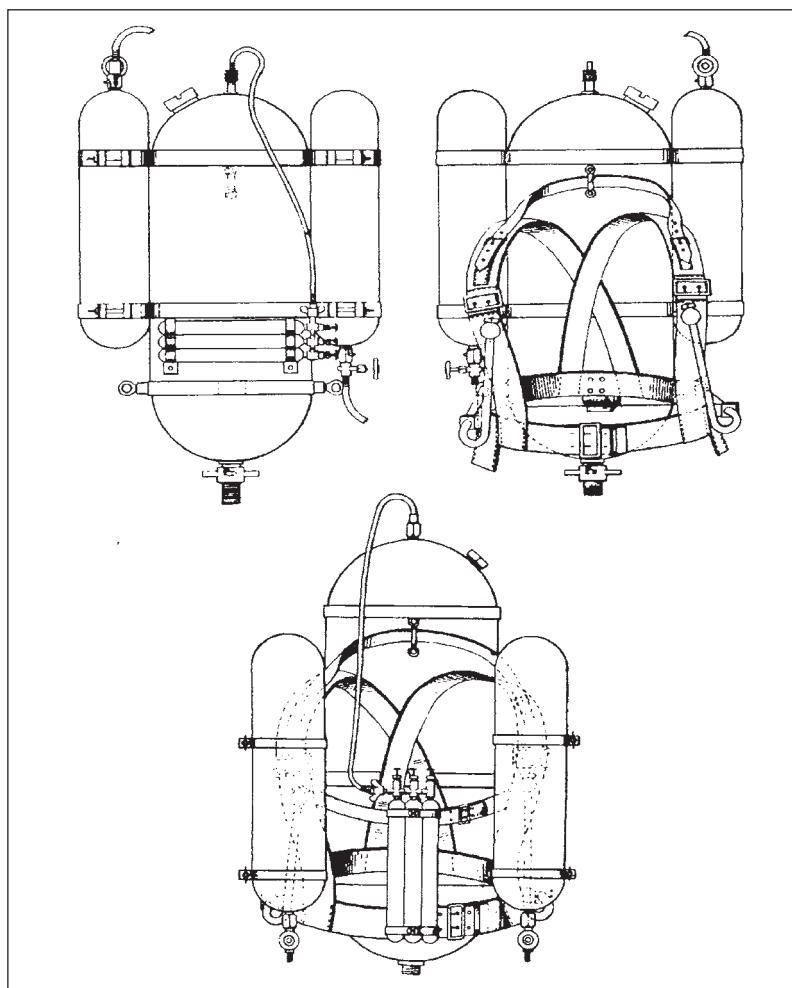
A diagram of the Livens Large Gallery Flame Projector, a hugely ambitious project for creating what was, in effect, a type of flame artillery. The whole structure measured more than 15m long. (Courtesy of Thomas Victor)



transported around the battlefield using carrying poles, which doubled up as braces to support the weapon when fired. Semi-portable weapons were adopted and were used in combat on occasions, but front-line reports by the operators were not favourable, because of the weapon's physical awkwardness. In one attack, by just two Semi-Portable detachments on 17 July 1916, nine members of the team were either killed or wounded as they struggled around the battlefield, and the devices had limited deployment subsequently.

One innovation by Livens that did give some reasonable service was the Livens Projector. Introduced in 1916, it was essentially a large trench mortar designed to throw substantial barrels of gas or flammable oil over ranges of 1,500m, the contents of the barrel being dispersed and ignited by a blasting charge. In concentrated salvos the Livens Projectors could deliver a devastating area attack, and they remained in relatively frequent use until the end of the war.

The British did make some attempts at designing more manageable flamethrower systems. These included the Norris-Menchem portable flamethrower, a 25-litre fuel tank married to a lance designed by Joseph



The Lawrence Knapsack Flame Projector Model 1915. The image top left shows a front view, and top right shows the carrying harness. The three small tanks on the front view at the bottom hold propellant gas, while the two large side bottles contain oxygen and chlorine. (Courtesy of Thomas Victor)

Menchem. Lieutenant Percy H. Lawrence, Royal Engineers, produced the Lawrence Knapsack Flame Projector Model 1915. The Knapsack was innovative in that it was a combined poison gas launcher and flamethrower, a separate tank containing chlorine gas that could be emitted via the lance. Lawrence thoughtfully designed a 'transportation roller' in which the fuel/gas system could be pulled across the battlefield like a camping water roller.

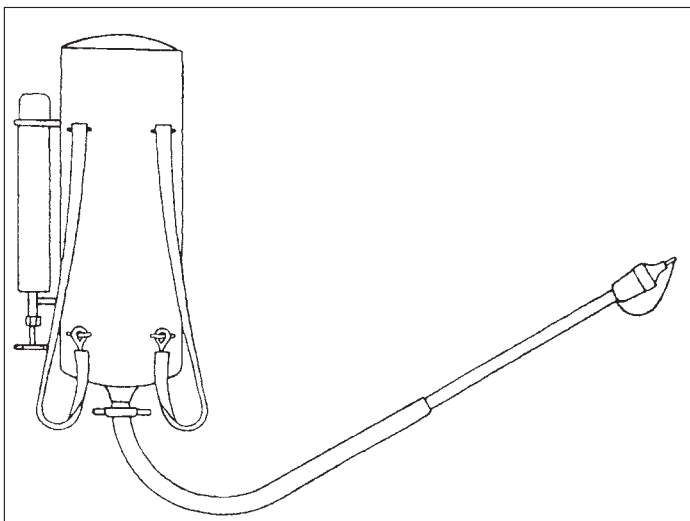
Other portable designs included one by Arthur Kitson, a lighting engineer. His design featured a rear bottle worn horizontally across the back, with the right hand operating a fixed lance while the left hand gripped a steadying handle. (The overall configuration was rather like that of a modern jet-pack.) An American, William A. Hall, also submitted a design, which used a pilot-light system of ignition at the nozzle. In early 1918, one Captain P.S. Hay of the Ministry of Munitions also submitted his 'Hay Flame Gun'. Firing was performed with either the tank stood directly on the ground, or hanging from a shoulder strap as a portable option.

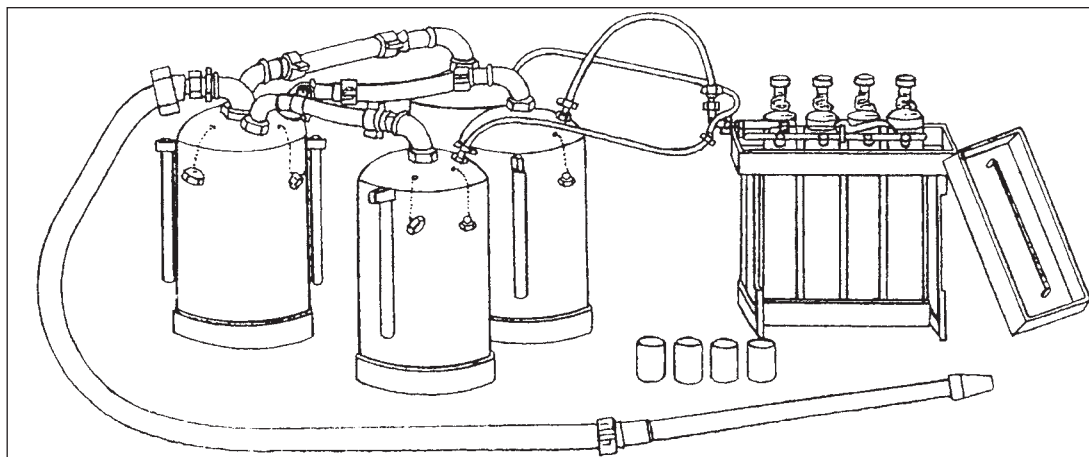
Although, as we have seen, the British did a lot more than just tinker with the idea of flamethrowers, actual battlefield use of the systems was sporadic and often ill-conceived. The French, by contrast, embraced flamethrowers with a similar gusto to that of the Germans. As with the Germans and the British, they adopted the principles of static, semi-portable and portable flamethrowers, or, to use a simpler terminology, large, medium and small. Its first weapons, introduced in the spring of 1915, were the Schilt No. 1 and Schilt No. 2 flamethrowers, static and semi-portable weapons respectively. The Schilt No. 1 measured 120x33cm and had an 80-litre capacity tank. It was a powerful device, with a range of 35m and burn duration of up to 25 seconds. The No. 2, by contrast, had just a 30-litre capacity and a range of 15m; however, it weighed less than half the weight of the No. 1, at 50kg. Yet it was the Schilt No. 3 that really ushered in a portable flamethrower for the French. Introduced in August 1915, it weighed just 23kg and burned for ten seconds, again with a range of about 15m. Its major disadvantage was that it was an all or nothing weapon – once the propellant valve was opened, the weapon raced through its entire

fuel contents. This defect was corrected in the No. 3's successor, the No. 3 bis, introduced in April 1916. It was capable of firing bursts and also increased the range to 20m. Both weapons were operated by three-man crews: one man carried the lance, another opened the propellant valve and the third looked after the nozzle fuses, or threw incendiary grenades.

The No. 3 bis proved itself to be a serious weapon during position assaults, and it was used relatively frequently in combat during the bloody years

The Schilt No. 3 was a rudimentary but effective man-portable flamethrower, the first of its kind in the French Army. Its biggest defect was that it could fire only one long, uninterrupted burst. (Courtesy of Thomas Wictor)



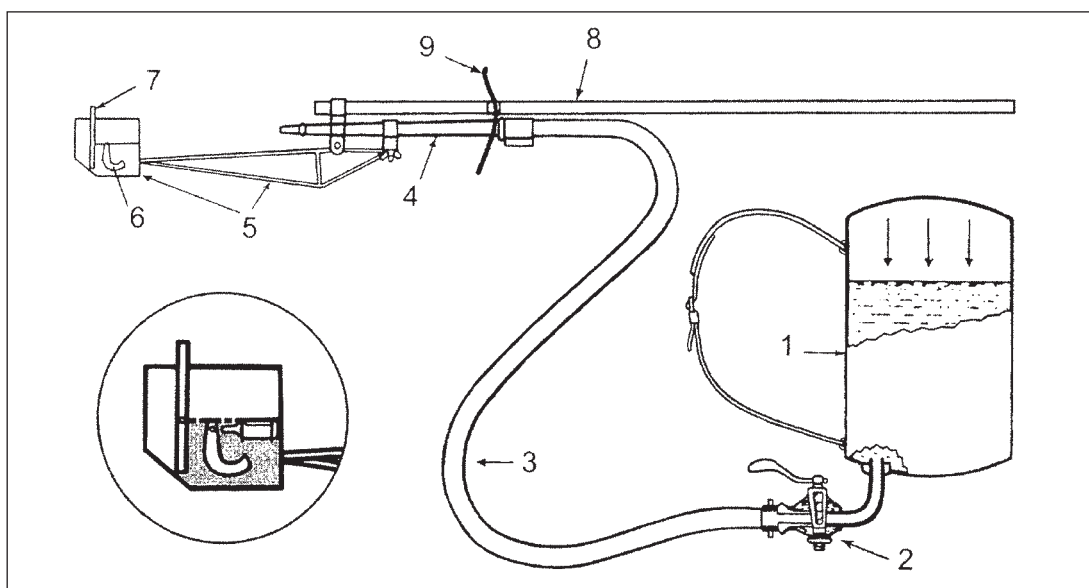


of 1916–18. The French ordnance authorities recognized that size was a crucial factor in creating a practical flamethrower, and in mid-1917 a smaller version of the No. 3 bis was formed and fielded, known as the P3. This weapon weighed 19kg and fired for ten seconds, but it could be operated with just two men, so was even better suited to assault roles. At the same time, the P4 variant was designed, which was even smaller and lighter and had excellent flame controllability from the lever on the flame lance.

The French, therefore, took the portable flamethrower to heart during World War I. They did not neglect the static flamethrower, however. As well as the Schilt No. 1 they also developed the L1 and L2 static flamethrowers, each working from multiple connected fuel and propellant bottles in a battery arrangement. Yet out of the 3,930 flamethrowers manufactured by the French during World War I, only 646 were static weapons – the rest were portable or semi-portable, with P3 (1,430 made) and P4 (320 made) devices being the most numerous types.

A diagram of the French L2 static flamethrower, showing its four interconnected fuel tanks that together held 121 litres of fuel, plus the four carbon dioxide cylinders on the right, which contained compressed carbon dioxide. (Courtesy of Thomas Wictor)

The Tovarnitski portable flamethrower. (1) oil tank; (2) oil release valve; (3) 2m hose; (4) nozzle; (5) tin ignite and support brace; (6) curved striker; (7) hinged flap; (8) wooden rod; (9) steel heat shield. (Courtesy of Thomas Wictor)



We see a similar pattern of manufacture among the Russians, who also came to comprehend the value of the portable flamethrower. Of the 11,446 flamethrowers produced by Russia between 1915 and 1917, 10,000 of them were of the Tovarnitski man-portable type. At first, the Russians relied on foreign flamethrowers, either captured weapons or some supplied by the British and the French. From the British, for example, the Russians took 36 Vincent and 50 Livens battery flamethrowers, plus a consignment of Lawrence Knapsack Flame Projectors. But in 1915 the Commission for the Preparation of Explosives initiated experiments in indigenous designs.

One of the first indigenous man-portable designs was the Tilly-Goskin of 1916, which featured a compressed air propellant tank that was manually charged by a hand pump, fitted prominently and somewhat awkwardly to the top of the main tank. Other designs were based directly on the British Lawrence model. Most influential was the Tovarnitski, which appeared in late 1916. It was a two-man device – one man carried the flamethrower and operated the release valves, while the other manned the lance. An interesting feature of the Tovarnitski was the ignition system, in which a bundle of cloth, impregnated with gasoline and an incendiary compound, was lit when the rush of oil activated a striker that in turn broke an ampoule of sulphuric acid, lighting the incendiary compound.

On the heavier side, apart from the British battery flamethrowers, the Russians also developed several static trench flamethrowers, including the Tovarnitski trench flamethrower, which could be used either on its own or in interconnected batteries of four devices, and the General Ershov System, wheeled around on its own carriage and tipped upright for emplacement in a trench.

A striking historical photo, with Tsar Nicholas II (fourth from right, in uniform) observing a demonstration of the Tilly-Goskin portable flamethrower. The handle atop the bottle was to provide compressed air pressure manually. (From the fonds of the RGAKFD in Krasnogorsk via Stavka)



FLAMETHROWERS OF WORLD WAR II

The six years of World War II were a period of intense innovation in weapons technology, in virtually every sphere. Automatic weapons, rocketry, artillery, air power, naval weaponry – all went through births or revolutions, transforming the destructive landscape of the conflict. With the increasing technological sophistication, it might be expected that blunt instruments such as flamethrowers might have begun a decline. In fact, they thrived on every battlefield, particularly in the hands of US forces in the Pacific. For tackling especially stubborn enemy positions at close quarters, once again the flamethrower proved that it had few rivals, although the threat environment in which the operators had to survive was, if anything, even more dangerous.

The Axis Powers

Naturally, the Germans had the advantage of experience when it came to developing flamethrowers during the inter-war years, although in the 1920s and early 1930s this development had to proceed in secret because of the restrictions of the Versailles Treaty. Once the treaty conditions were explicitly rejected following Hitler's ascent to power in 1933, flamethrower development accelerated accordingly. The first significant model to emerge in the 1930s was the *kleine Flammenwerfer*, often referred to as the Flammenwerfer 34 bez. 35 (or more commonly in English-language literature, the Flammenwerfer 35). The heart of the Flammenwerfer 35 was a single 11.8-litre fuel tank married to a compressed nitrogen bottle on the right-hand side. Maximum range was about 30m and burn duration was ten seconds. In many ways, the Flammenwerfer 35 was a perfectly acceptable flamethrower, but for its weight of 36kg, which led the *Pioniere* to request that a lighter version be manufactured.

An interesting next step taken by the German developers at the Weapon Proving Ground 5/1 was the Flammenwerfer 40. Here the Germans returned to the old Wex design, and the weight dropped significantly to 21.3kg, although at the expense of a reduced fuel capacity of 7.5 litres. The system also proved mechanically vulnerable, especially to impact damage to the main fuel tank. A far better solution was the Flammenwerfer 41, produced as Germany began its ill-fated adventure into the Soviet Union. The Flammenwerfer 41 had two regular cylindrical tanks in a horizontal arrangement, the lower one for 7.5 litres of fuel while the smaller upper tank held compressed hydrogen. Hydrogen

A German *Pionier* has help fitting his Flammenwerfer 35. The fuel tank was filled with a substance known as Burning Oil No. 19, consisting of blended tar oils, although other fillings were also used according to necessity and preference. (Cody Images)



A Lanciafiamme Spalleggiabile Mod. 35 flamethrower (bearing the Finnish designation liekinheitin m/40), photographed in Mikkeli Infantry Museum. 176 were purchased by Finland during the Winter War of 1939–40, but arrived too late; they were used during the Continuation War (1941–44). (Public Domain)



was also used for the ignition system, but in the terrible conditions of the Russian autumn and winter, this system became unreliable, so an ignition cartridge method was introduced to the lance. The result was the Model 42, and this became the mainstay portable flamethrower of the German forces for much of the rest of the war.

The Germans wrestled with several ongoing issues with their flamethrowers, but mainly with the desire to increase the fuel capacity without dramatically increasing the weight. They also sought ways in which to increase flamethrower range, based on the good distances Allied flamethrowers were achieving using thickened fuel. They never quite realized their goals. The subsequent Models 43, 44 and 44a fell short of their designer's objectives, being either too heavy (Model 43) or with limited fuel (Models 44 and 44a.) Furthermore, the flamethrowers could never quite break beyond the 25m range mark, as much due to the German fuel compositions as the design of the flamethrowers. Still, there was some innovation. The 44a actually used cordite as a propellant rather than nitrogen; although typical for late-war German design, this feature was an unnecessary distraction from more practical concerns.

In addition to man-portable flamethrowers, the Wehrmacht also invested in mechanized flamethrowers. Some PzKpfw II and III tanks were adapted to carry flamethrowers, in the case of the PzKpfw III as a replacement for the main gun, and flamethrowers were mounted to half-tracks as mobile infantry support weapons. The Germans, never shy of innovation, also produced a static, remote-controlled flamethrower known as the Fougasse. It was a one-shot weapon fed from a 19-litre tank. Once ignited, the fuel was ejected by a slow-burning explosive, throwing flame out to about 46m, blanketing an ambush area with flame. The idea, like so many others on the German drawing board, bore little fruit in reality.

The Italians were also busy with flamethrower design during World War II. Two models – the Mod. 35 and Mod. 40 – were produced prior to Italy's entry into the war, but the principal wartime model was the Lanciafiamme 41 (Mod. 41), a modified version of the Mod. 40. A captured example of this weapon was passed to US intelligence services in 1943, who subsequently provided their evaluation in *Tactical and Technical Trends*, No. 34, 23 September 1943:

According to British sources the two previously used Italian flame throwers, the 35 and 40, have become obsolescent due to their excessive weight. These models have been superseded by model 41. The weight of the new model is 40 pounds [18kg], and it has a range of from 17 to 22 yards [15.5–20m], and a fuel capacity of 1.75 gallons [6.6 litres; the Model 41 used a dual-tank system similar to the US M1]. The fuel used is a mixture of 9 volumes of heavy oil and 1 volume of gasoline. The duration of a continuous jet is five to six seconds.

An interesting feature of the Model 41 was its ignition system. When the operator pulled the control handle on the

lance, the change in air pressure in the lance caused a small flywheel generator to begin turning at speed, generating enough electrical current to send a spark to a spark plug, and thus ignite the fuel jet. (US Military Intelligence 1943b)

The Italian flamethrowers were decent designs, but the generally disastrous failures of Italy's military campaigns meant that they had little chance to flourish in open warfare, so their combat merits are unresolved. The Japanese also had some promising designs of man-portable flamethrower during World War II – the Type 93 and Type 100 – the latter being an improved and lighter version of the former. Both types featured twin fuel tanks with a propellant canister in the middle. Performance was similar – range was about 27m, discharge time around ten seconds. However, the gun of the Type 100 was more than 25cm shorter than that of the Type 93, making it far more convenient to operate from constrained spaces such as bunkers or log positions. Most interesting about the Japanese flamethrowers, however, was the ignition system, which caught the eye of US intelligence officers in a report from February 1943:

d. Fuel Nozzle and Ignition Mechanism

The fuel nozzle and ignition mechanism has an over-all length of 47 inches [1,193mm]. At the hose end, the tube is 1 inch [25.4mm] in diameter and tapers down at the nozzle end (where it passes through the ignition mechanism) to one-quarter of an inch [6mm]. The ignition mechanism depends on the firing of a .43-caliber blank cartridge into the stream of fuel. The nozzle, fitted in a 2½-inch by 5-inch [63.5×127mm] cylinder, contains the firing mechanism. Within the perimeter of the cylinder are ten .43-caliber holes to hold the blank cartridges. The cylinder revolves on a cam operated on each stroke of the firing handle. The firing handle is on the handle end of the nozzle, and is connected to the firing mechanism by a metal shaft. When the firing handle is turned, it performs a two-fold function. It fires the blank cartridge under the firing pin, and at the same time closes off the fuel by shutting off the valve in the handle. This prevents the flame from reaching the tanks in case of a flare-back. (US Military Intelligence 1943a)

A US soldier in New Georgia tries on a captured Japanese Type 100 flamethrower. The double fuel tanks held 11.3 litres of fuel, giving a burn duration of 8–10 seconds. (Cody Images)

What appears to have let the Japanese flamethrowers down was that perennial curse of tropical operations – reliability. The ignition system, for example, was given to malfunction in high-moisture environments (i.e. virtually the whole Pacific), and US combat reports never seem unduly concerned about the threat of Japanese flamethrowers.



The Allies

Flamethrower development proceeded apace among all the former combatants during the inter-war years, with the exception of the United States, for reasons explained below. In the case of the British, much effort went into developing a convincing standardized man-portable weapon, which had been sorely lacking during the 1914–18 conflict. They achieved this largely by copying the German Wex, to produce the Flamethrower, Portable, No 2, Mk I and II. True to the Wex, this weapon used the ‘doughnut’ design shape, but married to a two-handle flame gun that provided the operator with excellent controllability. A total of 18 litres of fuel was stored in the outer ring tank, while the spherical inner tank held compressed hydrogen gas. Burn time was 5–10 seconds and the effective range was 36.5m. The Mk I was introduced in May 1942, and was used mainly as a training device; it was the Mk II, introduced in the autumn of 1943, that became the main combat version.

Some 7,000 ‘Lifebuoys’ were produced during the war (500 Mk Is, the rest Mk IIs). Their combat reputation was mixed. Production problems caused low reliability, and at 30kg the weapon was also regarded as too heavy for one-man use. However, the Lifebuoy did bring in some innovations. The original weapons had a spark igniting system, but on some flamethrowers a ten-shot revolving cylinder was fitted at the nozzle, each cylinder containing a pyrotechnic cartridge. When the fuel was released and

a cartridge ignited, the result was roughly a one-second burst of flame, giving the operators ten controlled shots. To deal with the weight issue, the British did redesign the Mk II, producing the Flamethrower, Portable, No. 5, Mk I, which was significantly lighter. Known as the ‘Ack-Pack’, the No. 5 was promising but didn’t get beyond the experimental stage during the lifetime of the war.

Beyond the scope of this book, the major focus of British flamethrower development lay in the development of high-capacity vehicular flamethrowers. The Bren Gun Carrier, Ram Personnel Carrier, Churchill tank and Sherman tank were all produced in flamethrower variants, some of extreme power. The Churchill ‘Crocodile’, for example, pulled a two-wheeled trailer containing 400 Imperial gallons (18,184 litres) of fuel, sufficient for 100 seconds of burn time out to ranges of 110m. Such weapons served in North Africa, Italy and Western Europe, and became greatly feared by Germans in fixed positions.

The Soviets also took their flamethrower designs further in World War II, not least by building tactical awareness into the very structure of their man-portable weapons. The chief man-portable types used by the Soviets were the ROKS-2 and ROKS-3. Soviet designers created the ROKS-2 to look

A No. 2 ‘Lifebuoy’ flamethrower. The Chindits in Burma were equipped with weapons like these to reduce Japanese pillbox defences. (Neil Grant)



specifically like an M/91-30 military rifle and a rucksack, the 9-litre fuel tank and nitrogen propellant tank covered with thin sheet metal to disguise their appearance. Ignition was via pyrotechnic cartridges, and the burn time was very short – just 6–8 seconds. Yet by disguising the weapon, the Soviets marginally improved the survivability of the operator, by making him nearly indistinguishable from the regular infantrymen around him. The effort of the disguise eventually became too much for the manufacturers, however, and the later ROKS-3 dispensed with the backpack design and left the tanks exposed.

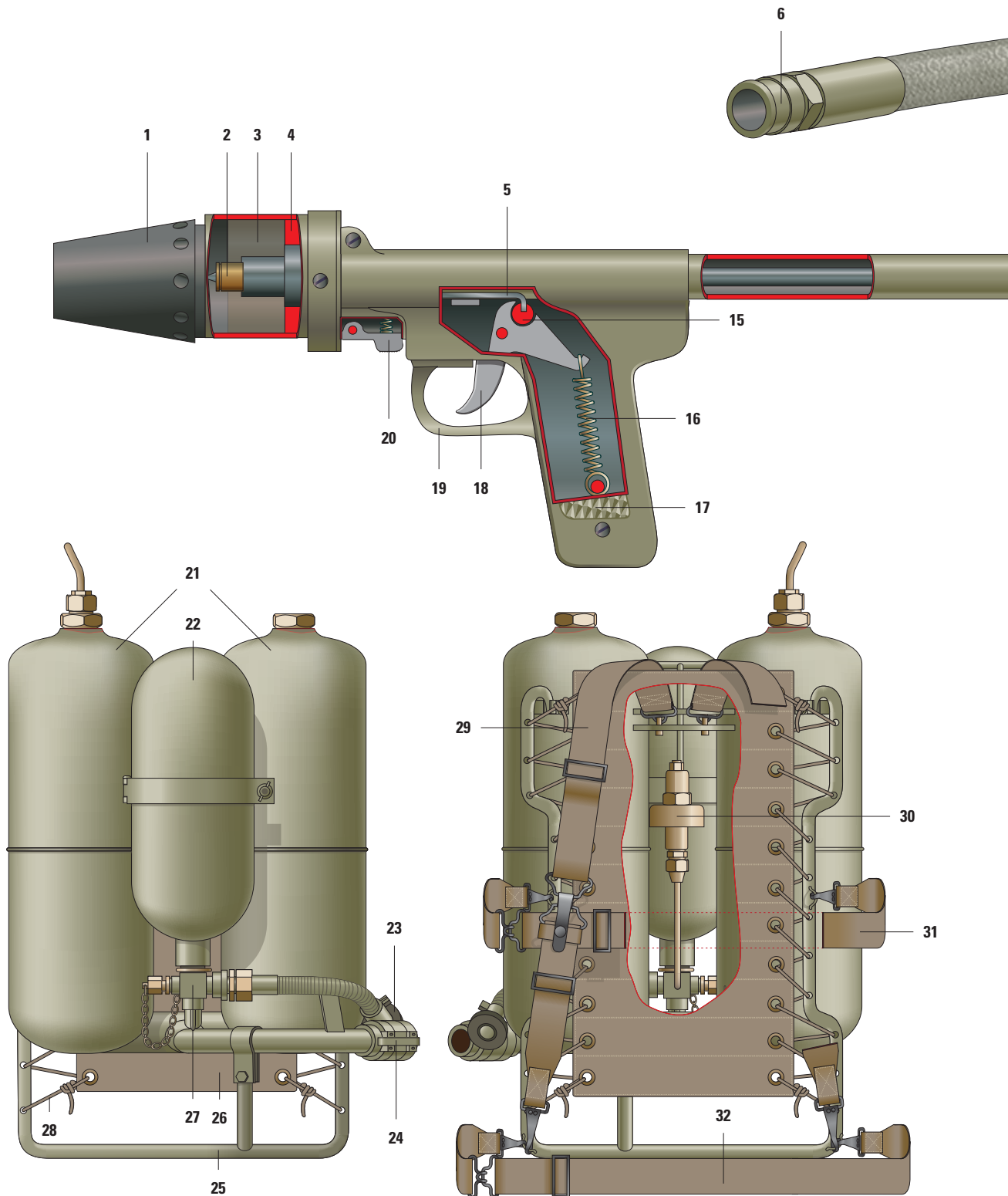
The United States presents perhaps the most fascinating story of flamethrower development in World War II. It ended World War I with little interest in the weapons, nor did it make any substantial attempts at creating new designs during the inter-war years. Only when the US authorities received reports of flamethrower use in Europe in 1939–40, were they spurred to invest in flamethrower technology. Thus in the spring of 1940, the Chief of the Chemical Warfare Service (CWS) was ordered to begin work on designing both man-portable and mechanized flamethrowers, with a professionally challenging three-month deadline to produce working models. The CWS co-opted the expertise of fire-extinguisher manufacturer Kincaid, and they remarkably produced a prototype by October the same year. It was this prototype that, through subsequent trial and adjustment, became the 'Portable Flame-Thrower M1', the foundation of all American man-portable flamethrowers. The M1 featured two propellant fuel tanks mounted side-by-side on a backpack harness, with a compressed gas tank centred atop the two. The tanks and gas fed out to a lance, which featured a small hydrogen gas cylinder along its length. This cylinder was allied to a battery-powered spark ignition system, together providing the requisite flame to ignite the fuel mix when it was ejected. In reality, the ignition

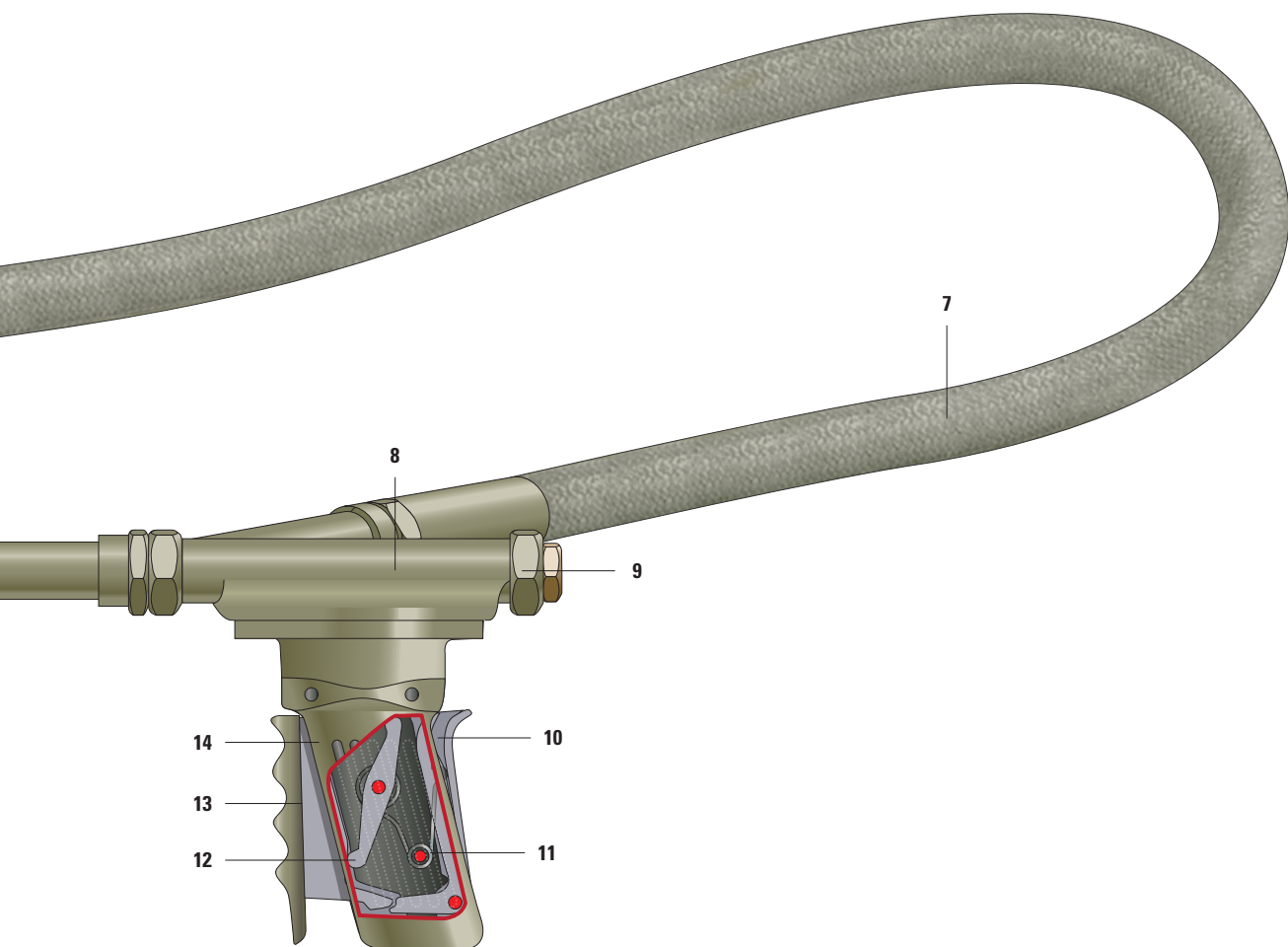


The Soviet ROKS-2 had a tank system designed to look like a common soldier's backpack, the purpose being to confuse enemy snipers, who deliberately targeted flamethrower operators. (Courtesy of the Central Museum of the Armed Forces, Moscow via Stavka)

THE M2-2 FLAMETHROWER EXPOSED

M2-2 Man-Portable Backpack Flamethrower (not to scale)





1. Ignition shield
2. Valve needle assembly
3. Ignition cylinder
4. Spring case
5. Trigger rod
6. Fuel-hose connector
7. Fuel hose
8. Valve body
9. Valve-spring retainer
10. Safety grip assembly
11. Valve-grip spring
12. Rocker arm
13. Valve lever assembly
14. Valve grip
15. Bearing
16. Trigger spring

17. Grip
18. Trigger
19. Trigger guard
20. Latch pin
21. Fuel tanks
22. Pressure tank
23. Pressure-tank release valve
24. Tank coupling
25. Harness frame
26. Harness panel
27. Pressure-tank valve
28. Harness straps
29. Shoulder harness
30. Pressure regulator
31. Chest harness
32. Belt harness

system was the key weakness of the M1 and of the subsequent M1A1, as the batteries were prone to failure in battlefield conditions. The range of the weapon was around 27m.

The M1 was to serve throughout World War II, but in December 1942 a variant model was introduced, the M1A1, of which 14,000 were built. It was essentially a modification of the M1 to fire the new napalm-thickened fuel, which was more accurate and extended the range out to 46m. Both weapons blazed a trail in the Pacific particularly, but they were far from perfect. Not only was the ignition system unpredictable, and other components prone to failure, they were also heavy (filled, the M1A1 weighed 32kg). Thus in 1943–44, work began on potential replacements for the M1A1, and the outcome was the M2. This weapon was stronger, sturdier (albeit heavier) and more reliable than the M1/M1A1. Its serviceability was improved, as was the speed and convenience of filling the two fuel tanks. Most significantly, its E4 gun had adopted pyrotechnic cartridge ignition, five of the cartridges contained in a revolving cylinder. With thickened fuel it had a maximum range of 40m.

The M2 was a fine weapon, and was given further minor wartime enhancements in variants such as the M2-2. Other variants would go on to serve the US forces in both Korea and Vietnam. The M2 also formed the foundation of the M3 Auxiliary Flamethrower, which was designed to be fitted to armoured vehicles. Flamethrower-equipped Stuart and Sherman tanks came to be central to the Americans' firepower dominance in the Pacific, dousing Japanese positions with hundreds of litres of fuel from behind a protective armoured shell.

A US Marine in the Pacific opens fire on a Japanese emplacement with an M2-2 flamethrower. Note the bulbous flame-gun head, which contained five pyrotechnic charges in a revolving cylinder. (Cody Images)



POST-WAR FLAMETHROWERS

World War II was the apogee of flamethrower design. For reasons explored in greater detail below, the post-war world showed a slowly declining interest in flamethrower weapons, its focus shifting to new weapons types while also shying away from the political fallout that could gravitate to flame operations. The United States was, for a time, still one of the most active developers of flamethrowers, which found a combat context in both Korea and Vietnam. In addition to mechanized flamethrowers, the US troops in these conflicts also used the M2-2 and an improved version, the M2A1-2, introduced in 1952 with improvements to features such as the harness system and safety valves. In 1958, another advancement was made, this time in wand design. The M2A1 tank group received the new M7 wand, which was shorter than the M2 wand and had a simplified ignition system. Together the two components were designated the M2A1-7. Further improvements, particularly in the layout and weight distribution of the fuel tanks to save weight, resulted in the M9A1-7, a mainstay flamethrower of the Vietnam conflict.

A more curious US design appeared in 1959, known as the M8 One Shot. Here the soldier was equipped with a tubular weapon filled with incendiary fuel, arranged in a kind of flattened horseshoe configuration. The outer body was made of fibreglass, and the weapon could be either fired from a hand-held position or ignited remotely by trigger, lanyard or electrically as a static device. When triggered the M8 delivered a single four-second burst of flame, an incendiary cartridge forcing a ball around the horseshoe pipe and driving every scrap of fuel outwards. Ignition was by another incendiary cartridge.

The US flamethrower story essentially terminates in the M202A1 FLASH (FLame Assault SHoulder Weapon). Here is not a traditional flamethrower. Rather it is a four-barrel rocket launcher, each barrel firing an M74 rocket filled with Triethylaluminum, a substance similar to white



A US soldier lets rip with an M8 One Shot, a fibreglass single-shot flamethrower that entered development during World War II. It could fire a single four-second burst. (Ryan Crierie)

phosphorus and which burns spontaneously at extreme temperatures when exposed to air, with a bursting radius of 20m (although burning fuel can be scattered over a 60m area on impact). The rationale behind the M202A1 was logical enough – it could deliver flamethrower effects but at ranges of up to 750m, with an accuracy sufficient to shoot through a bunker aperture at 50m. The M202A1 has been produced since 1978, but it appears to be little used tactically, modern US forces drawing on the wider range of thermobaric and explosive weaponry.

Flamethrowers still remain in the US inventory, but the picture regarding other countries is mixed. In Britain, for example, the flamethrower died out relatively quickly in practical use, although some Lifebuoy weapons and vehicle-mounted flamethrowers remained in stocks during the 1950s and 1960s. The Soviet Union, by contrast, developed new types such as the LPO-50 Light Infantry Flamethrower. This was tested and adopted around 1967–68, and was a fairly conventional three-tank backpack design, firing up to three 2–3-second bursts, the fuel ignited by an electrical ignition system allied to pyrotechnic charges. Tellingly, however, in the late 1980s the Soviets introduced the RPO-A Shmel, like the M202A1 a man-portable rocket launcher classified as a flamethrower on account of its thermobaric and incendiary warheads. Here, in many ways, is where the design story of the flamethrower leads. The spread of man-portable missiles has largely – but, as we shall see, not completely – kicked away the rationale for man-portable flamethrowers.



The LPO-50 was classified as a 'light infantry flamethrower'. It was distinctive in having three tanks and delivering three 2–3-second shots, each burst using up the contents on one of the tanks. A black-powder cartridge was used as the propellant for each tank. (Neil Grant)



USE

Unleashing hell

The introduction to this book may have done flamethrowers something of a disservice. Viewed from one perspective, they are blunt instruments indeed, vessels for launching nothing more than a scorching blast of flame at a vulnerable enemy. Yet to focus on this aspect of their use is to deny the versatility of the flamethrower as a tactical platform. The world wars were the ultimate pressure-testing environments for weaponry, and although scores of devices were found wanting and allowed to lapse from service (or remained in use in the hands of agitated soldiers), the flamethrower largely proliferated and succeeded, despite some substantial defects. Why this is so is the principal focus of this chapter.

A fascinating US wartime poster issued by the National Fire Protection Association, using a soldier armed with an M1 flamethrower to make its point. (NARA)

FLAMETHROWER EFFECTIVENESS

The effect on target

To judge the utility of the flamethrower, the first grim port of call is a deeper study of the effect on targets – humans and physical structures. One point to note straightaway is that a flamethrower operator would rather rarely engage exposed human targets on open ground, unless *in extremis*. Small arms and explosive weapons handle such targets



far more convincingly, at much safer ranges and within more acceptable limits of ammunition expenditure. (If you have only about nine seconds of fuel burn, devoting a couple of seconds of that time to attacking one or two individuals is essentially a waste of ammunition.) However, flamethrowers were ideally suited for rooting out emplaced individuals, through two principal killing mechanisms. The first, and visually most obvious, is burning. A flamethrower jet burns with temperatures in the region of 1,200 degrees Celsius, and with a suitably viscous fuel the blazing mix sticks to whatever it strikes. Any human truly unfortunate enough to be engulfed by the flame would experience some moments of consuming agony, but fairly rapid incapacitation and death from systemic burns and also respiratory failure owing to breathing in the super-heated air and oily smoke. Thickened fuels adhere firmly to skin, clothes and equipment, making smothering the flames difficult even by the traditional method of rolling on the ground. Even if an individual received only localized burns, typically from being 'splashed' by gobbets of burning fuel rebounding off nearby surfaces, then the result would usually be appalling third-degree burns to the affected area, requiring the soldier's hospitalization and extended medical treatment.

Yet direct burning was just one of the perils facing the occupants of a bunker or other strongpoint. Asphyxiation was another threat, depending on the overall internal volume of the space the defenders occupied. A one- or two-second burst from a flamethrower would smother a strongpoint with fire, the fire sucking out and consuming the oxygen from the interior, even if the flame itself didn't reach directly inside, while also producing high volumes of deadly carbon monoxide. Smoke ingress, both from the oily flames and from the combustion of other materials, would make life inside the strongpoint doubly inhospitable. If the occupants could not move deeper inside a more extensive space, or break outside from what was rapidly becoming a death trap, they would suffocate.

The destructive power of the flamethrower could extend very deep indeed into a protected hillside. During fighting in north-west Luzon (the largest of the Philippine Islands, in the north of the archipelago) between 21 and 28 January 1945, troops of the US Army's 3rd Battalion, 158th RCT, had to neutralize seven extensive cave systems dug into the hillsides

British troops fighting in Northern Europe during World War II rely here on a flamethrowing Sherman 'Crocodile' to make headway against German positions. (HMSO)



above Damartis. These were no shallow scrapings. The tunnels in some places extended more than 10m into the hillside, with T-junction connections linking them up and the classic combination of palm logs, sand and concrete providing well-concealed and durable entrances, from which the US troops took extremely heavy fire. A typical attack on these positions was conducted by Company K on 25 January near Cataguintangan. White phosphorus grenades were thrown in to create a smoke screen and to burn away surrounding vegetation, then a flamethrower team moved forward and managed to fire a long burst directly into the tunnel mouths. One immediate effect of the flame was that several burning Japanese soldiers fled outwards, quickly dispatched by the waiting riflemen, then many others, unharmed but in unimaginable panic, fled outwards where they were also killed by small-arms fire. Unknown numbers remained inside, however, where the flames burned deep within for some considerable time. Once it was clear that the threat had been neutralized, the US soldiers ventured inside to inspect the damage. The burn marks and numerous charred corpses inside the cave made it clear that the flame, produced by a standard oil and gasoline mix, had billowed deep inside, the flames actually bouncing off the angles of the cave walls and working their way around corners. And even though hiding places were to be found in the deepest recesses of the tunnels, the occupants there were suffocated – there was literally nowhere to hide. A total of 15 Japanese soldiers died from the direct effect of the flamethrower bursts, and an uncounted but larger number died as they fled the flames on to the guns of the waiting infantry. This single action was just one of countless other flamethrower engagements that played out across the landscape of Luzon in 1945.

What emerges here is a key point to understanding the effectiveness of flamethrowers, to which we shall return several times. Remember that flamethrower teams rarely, if ever, worked in isolation from general infantry support, usually in the form of riflemen and/or grenade throwers. Within these teams, the flamethrowers typically performed three roles: (1) destruction of enemy personnel and matériel; (2) suppression of enemy personnel, driving them to ground in a similar way to intense shelling or machine-gun fire; and (3) forcing an enemy to disperse or reveal themselves, these options being preferable to burning or suffocating to death. So to the threat of burning and suffocation we can add the sheer psychological effects. Just the presence of flame weapons can force an enemy to make tactical errors. The fear of being immolated in flames is a deep-seated, almost primeval terror in human beings, and a mixed flamethrower-and-infantry team can channel this terror alone into forcing the enemy to break cover and run, straight on to waiting guns.

The US soldier on the left is armed with an M1A1 flamethrower, an improved version of the earlier M1 and standardized in December 1942. The M1A1 lance did not have the 10-degree barrel bend of its predecessor. (Cody Images)



Another tactical advantage of the flamethrower lies in its anti-matériel effects. Defensive structures can be shockingly resilient to high-explosive force. Throughout both world wars, it was a common experience for soldiers on all sides to watch a preparatory bombardment being laid down with such intensity that they expected their forthcoming offensive to be little more than an exercise in enemy casualty collection. Veteran soldiers quickly became disabused of such notions. By the first day of the battle of the Somme on 1 July 1916, for example, the British had dropped more than a million shells onto the German lines in a week-long bombardment, but still the British troops took 60,000 casualties in one day of fighting. The United States had its illusions similarly pricked in the Pacific. Tiny atolls such as Tarawa, or larger objectives such as Iwo Jima and Okinawa, were pummelled with extraordinary barrages of naval artillery and aerial munitions, entire landscapes being re-contoured by the firepower, but still the soldiers who eventually landed faced the most violent and concentrated resistance from an expertly dug-in enemy.

During actual assaults on positions, the stubbornness of the defence could be maddening. Much of the small-arms fire directed against a bunker or pillbox would either be absorbed by surrounding materials such as earth, sand or trees or simply be directed off hardened surfaces. Those bullets that did make it inside the position would often have a predictable line of ricochet, enabling the defenders to avoid the dangerous angles. Typically, the best recourse was to bring up high-velocity explosive

weaponry, but even a tank shell or bazooka round was no guarantee that a position could be subdued.

Here the flamethrower came into its own, succeeding where many other weapon types failed to dislodge or destroy the enemy. Flamethrowers offered several key advantages in the anti-position role. First, flame is a 'searching' element, working its way around corners and into angles, thereby reducing the number of places to take cover. (The asphyxiating effects noted above can mean that, from an anti-personnel perspective, there can be literally nowhere to hide.) Second, flame has a persistent destructive effect that does its work over a long duration. The impact effects of a bullet lasts milliseconds (unless it embeds in a human), but a flame-drenched position could burn for many hours, the fire progressively eating away at the combustible fittings and equipment within the

A Marine of the 1st Marine Division on Peleliu in September 1944 burns out a Japanese sniper position with his flamethrower. (Cody Images)



bunker but also the structural integrity of the position itself. Fire destabilized brickwork, concrete and structural steel over the course of a prolonged burn. Bunkers made from natural materials such as logs burned like campfires and would eventually reduce to ash. But even if the main body of a structure was not significantly degraded by the voracious flames of the flamethrower, other elements of the position's overall functional efficiency would be affected. Power and lighting cables, if installed, were destroyed by direct flames or extreme proximate heat. Communications equipment was rendered ineffective through the loss of exposed antennae or communications lines. Any external air venting or water piping would be severely damaged. The outer case of sandbags burned and burst open, obviating the bags' protective qualities. Exposed gun barrels, even those of major artillery pieces, could be warped or materially weakened. Rope or wire lashings were degraded or broken. Thus even if a position survived a flamethrower attack, it was likely to be a smoky shadow of its former self, with a much-reduced defensive capacity and limited tactical integration. Another key effect of the flamethrower is that its heat and flames can result in the sympathetic detonation of enemy munitions, such as small-arms ammunition, grenades, artillery shells, flares and pyrotechnics and also fuel stores.

The material destructiveness of the flamethrower has also found practical applications in terrain clearance, particularly in jungle environments or terrain with dense grassland. During the Americans' World War II battles in the Pacific, and those of the British in Burma, flamethrowers were a violently probing means for flushing out snipers hidden in dense bush, or for clearing foliage from lines of fire around other objectives. In jungle environments, the flamethrower was proficient at burning off leaves, grasses, vines and bamboo, depriving enemy snipers and riflemen of concealment, if not cover. Naturally, care had to be taken. The flamethrower operator had to observe both the nature of the terrain and the prevailing winds. It would not be a good idea, for example, to send a burst of flame into tinder-dry woodland on a cloudless midsummer day with the wind blowing towards you. The outcome would likely be at best an inconvenient localized blaze or at worst a major forest fire. Team leaders would therefore have to make due acknowledgement of the environmental conditions before sending a flame out into the bush. On some occasions, however, a terrain fire was just what was intended – the Germans initiated some major forest and grassland fires with flamethrowers in Russia and the Ukraine during anti-partisan operations in 1941–44.

On the Eastern Front during Operation *Barbarossa*, a German flamethrower team assaults a Soviet-held position. These men probably belong to a flamethrower platoon, which had a total of nine flamethrowers. (Cody Images)





A German soldier opens fire with his *Flammenwerfer 35*. The weapon had a burn duration of about ten seconds. Like all German flamethrowers, the *Flammenwerfer 35* struggled to reach ranges of more than 30m. (Nik Cornish at www.stavka.org.uk)

The flamethrower also had useful properties for tackling enemy vehicles, up to and including main battle tanks. Even though a tank's metal armour was naturally resistant to penetration by the flame, external fires could still transmit considerable heat through the bodywork to affect both the crew inside and the functioning of key mechanisms, such as turret traverse gears. Gun barrels could be damaged, and fixtures such as radio antennae and lighting would be destroyed, rendering the vehicle either combat ineffective or at least requiring its temporary withdrawal from the battlefield for repairs. Most serious, however, was the threat that the flamethrower posed to the engine compartment and fuel system of the vehicle. The flames could starve the engines of air and smoke would block the air filters, stalling the engine, and burning fuel could drip through grilles to set fire to the engine itself, or ignite fuel lines. In such cases it wouldn't be long before the tank at least became a mobility kill, vulnerable to assault parties. Soviet grenade teams, for example, would quickly swoop in on the flame-immobilized vehicle to finish it off, and such was their success that the Germans also adopted the tactic. On occasions, however, the flamethrower might generate internal fires that alone resulted in the catastrophic destruction of the vehicle – either from fuel igniting or even from spontaneous detonation of ammunition.

Fuel types

In the same way that firearms are actually just mechanisms for delivering bullets, flamethrowers are devices for ejecting and igniting fuel. To extend the comparison further, in the same way that ammunition is the most important component of a gun, with flamethrowers the fuel used is also of paramount importance to how the weapon performs and its utility against certain types of structure. Until World War II, there was little innovation in fuel composition, being largely a mix of oil and petrol. The oil provided a degree of viscosity and liquid weight, which enabled the mixture to be

thrown with a predictable trajectory and range. Yet in itself oil was difficult to ignite, so petrol was added to lower the flash point and provide more dependable ignition. Such low-viscosity fuels had their own set of properties and advantages. They produced a searingly hot and wide cloud of flame, one that fanned out into a broad blast ideally suited to saturating an entire position or stretch of trench with flame. Fired into an enemy-held cave, directly through the aperture of a bunker, or along the entire length of a trench section, such a flame would have devastating effects, the billowing and expansive blast leaving few places in which to hide. In addition, the petrol-oil mix proved to be good for vegetation clearance, as it cut a broad leaf- and grass-shrivelling path around a position.

However, such a type of flame did have its limitations. A key restriction was range. The low viscosity meant that the fuel had a light weight, and therefore slowed down quickly when it met air resistance, reducing its range considerably, even when ejected under high pressures. Note that neither simply altering the nozzle configuration to narrow the fuel stream and therefore increase its pressure, nor increasing the pressure of the gas propellants, provides a solution to the problem, by virtue of the fact that an increase in fuel velocity is counteracted by an increase in air resistance. The problem was naturally made worse by crosswinds or headwinds. German experiments with *Flammenpanzer* jets – bearing in mind that vehicle-mounted flamethrowers are capable of the greatest pressures – found that the maximum weapon range of around 80m was reduced to about 50m if there was a strong crosswind, and no amount of pressure adjustment could correct this fact.

With man-portable flamethrowers, direct strong headwinds could even be an actual threat to the operator, blowing the flame and heat backwards and speckling the team with drops of unburnt fuel, increasing the risk of clothing ignition. As a clear indication of the dangers of the low viscosity fuels in strong winds, consider the first French flamethrower action of World War I, a particularly inauspicious event. On 6 June, a 50-strong team of firefighters, part of the Paris Firefighting Sapper Regiment, went on the attack with 18 Schilt No. 1 flamethrowers at Vauquois. When the French troops unleashed a hissing barrage of flame, the winds lifted it and pushed it back over the French positions. Ammunition and other flamethrower containers caught fire and blew up. In total, French casualties from the incident were 25 dead, six missing and 127 injured.

Another important consideration is that to achieve long ranges from a flamethrower weapon increases the expenditure of fuel dramatically. Therefore a man-

On Kwajalein Atoll in February 1944, a US Marine torches a Japanese-held building. Note the billowing flame, indicating a low-viscosity fuel composition. (Cody Images)



portable weapon might be able to deliver six or seven blasts to a range of 10–15m, but only two or three blasts to ranges of 30m. Again, this problem was somewhat exacerbated by the low-viscosity fuels. The lightness of the fuel results in the more rapid dispersion of the ignited jet when it hits the air, meaning that a greater volume of fuel has to be expanded to achieve range requirements. Furthermore, although a broad flame has some destructive advantages, it is actually a poor performer when directed on the outside of resilient structures. Even if the blast pushes up against embrasures or other narrow openings, it is unlikely to push far inside. Instead the entire flame tends to wrap around the exterior surfaces, with little or no penetration. The fact that the flame could, at a distance of 10m or more, be possibly 4–5m wide at impact point also made it hard to aim the jet with anything but general accuracy.

During World War I, most of the combatants recognized this problem, although made only limited steps to solve it. Some sought to increase the viscosity of the fuel, therefore making it fly better through the air to longer distances, while also narrowing the jet of flame to make it more directable and accurate, ideal for shooting through narrow embrasures from decent stand-off distance. The high-viscosity fuel would also have the advantage of adhering more readily to slick surfaces, rather than rolling off as many light fuels did. Initial steps were made by the Germans towards this goal by adding a small quantity of pitch or asphalt to the fuel, just enough to thicken the fuel without significantly increasing the delivery system pressure and not enough to adversely affect the ignition point. The addition of pitch/asphalt proved a reasonable success, but the heavy weight and viscosity of the materials meant that the amounts that could be added were small, and the German flames generally remained of the oil-petrol variety through both world wars.

The greatest advances in the study of flamethrower fuels were made by the Americans. In his study of the development of the man-portable flamethrower, McKinney explained some of the investigations during the late years of World War I:

A jet from this Flammenwerfer 35 scorches through woodland. The size of the fuel tank is very apparent here; when full the whole system weighed 36kg. (Nik Cornish at www.stavka.org.uk)



Late in World War I, the American University research group recognized the importance of increasing the viscosity of flame thrower fuels without increasing vapor pressure. That is, if gasoline could be thickened by the addition of a small amount of high viscosity material, the vapor pressure would not be affected materially. The practice of making lubricating greases by heating petroleum oils with sodium, calcium or aluminum soaps is an old art. Sodium stearate (soap) was investigated but proved to be a poor choice because it failed to increase viscosity, giving instead a material with the appearance of applesauce. However, this basic research laid the ground work for the successful developments carried out during World War II. (McKinney 1949: 35)

The end of the war in 1918 took the urgency out of further research into the creation of high-viscosity fuels. However, two decades later the motivation returned, as war thundered across Europe and, from December 1941, the Pacific. McKinney points out that the US Chemical Warfare Service (CWS) and the National Defense Research Committee (NDRC) both began conducting experiments to produce a viscous incendiary compound, one with applications in air-dropped weaponry as well as flamethrowers. Various substances were added to the mix, but one eventually stood out above all others – napalm.

The composition of napalm was some 25 per cent aluminium naphthenate and 75 per cent aluminium soap of coconut fatty acids. (The word ‘napalm’ comes from a combination of the words ‘naphthenate’ and ‘palm [oil]’.) Napalm produced a terrifying anti-personnel effect. Its glutinous nature meant that it stuck to whatever it struck and burned with a murderous intensity. Its sticky mass also made it harder to extinguish than other sources of flame. Napalm was in production by late 1942, and went through several compositional changes during its lifetime to ease its manufacture and to increase its effect. Also during 1943, napalm began to find a use as a thickening additive to flamethrower gasoline. By adding napalm to the flamethrower fuel tanks, the jet of flame was narrowed considerably, and held its shape better over the range of its flight. Indeed, some photos of US flamethrowers from the later years of the war show jets of almost pencil-thin fuel and flame arcing out to distances of many metres. These jets were ideal for the more acute shooting required by flamethrower operators in the Pacific. Suddenly it became a viable option to shoot through a narrow machine-gun aperture or through the driver’s vision slit on a tank, even at distances in excess of 20m.

A soldier of the US Army Signal Corps, 95th Division at Fort Bullis, Texas, tests out the M1A1 flamethrower on a mock bunker in June 1943. (NARA)





The Abwehrflammenwerfer 42 was a German static defence flamethrower. With a fuel tank holding nearly 30 litres of fuel, the flamethrower was buried at key ambush locations and was typically triggered by tripwire, producing a 27m flame for about one-and-a-half seconds. (US Govt)

But the process of mixing napalm to flamethrower fuel was at first something more of an art than a science. Getting the right mix was problematic because the early forms of napalm had a tendency to change in their chemical composition over time, the main issues arising from the mixture's absorption of water moisture. Such a problem was naturally acute in the humid tropics, and was exacerbated by the fact that the early napalm mixtures were packed in porous cardboard containers. In some cases the mixture became so corrupted following pre-loading that by the time the weapon was actually used, the mixture was in fact little different in consistency to unmodified petrol. McKinney notes that both the CWS and the NDRC produced recommended proportions of napalm-to-fuel mix, but in practical terms the mix was often dictated by the experience and preference of the field units:

A mixture of 8 percent napalm was recommended by the Chemical Warfare Service in 1942. In August 1943 the Corps of Engineers recommended 4.5 percent, whereas the Infantry Board favored a "bushy" flame and recommended a 3 percent mixture. In October 1944 the Infantry Board approved the use of 4.2 percent napalm to which sufficient water had been added to give a viscosity equivalent to a 3 percent fuel. (McKinney 1949: 36)

Although we cannot know the composition of the fuel used in the following – from the European Theatre of Operations (ETO) in 1944 – the accuracy implied suggests a thickened jet:

While the 29th Infantry Division was fighting near Brest, the 116th Infantry ran into a pillbox and, after working on it for a half-hour with hand grenades and small arms without success, brought up a flame thrower. The weapon had been partially spent. However, the operator crawled to within about twenty yards [18m] of the position and placed a burst of flame in one doorway, a second burst in another opening and the third burst back in the first doorway. The pillbox was covered with a camouflage net which caught fire and added to the flame. The five Germans inside immediately began to yell and scream, but could not come out because of the fire. It took about ten minutes for the flames to subside sufficiently to allow them to come out and surrender. They were only slightly burned but their nerves were shattered and they shook their heads dismally as they passed the flame thrower sitting outside on the ground. (McKinney 1949: 199)

This account shows, like many others in this book, how the flamethrower could get the desired results when other more conventional weapon



Okinawa, May 1945. A flamethrowing Sherman tank sprays a thin jet of burning fuel onto a Japanese position; the infantryman on the right prepares to engage fleeing occupants with his rifle. (Cody Images)

systems had failed. Here the operator, from a range of 18m, puts a jet of flame through two apertures, shooting through the door twice as if just to illustrate that it was no fluke. We can also note the contributory effect of secondary fires, in the form of the burning camouflage net. Interestingly, none of the Germans was killed by the flames. Had the operator been close enough to fire in a burst of low-viscosity fuel, it is likely that the occupants would have been incinerated. One side-effect of thickening the fuel with napalm was often that the actual flame content of the jet was reduced; some wartime footage shows jets that are scarcely burning at all during the flight, igniting with a bit more vigour when they actually strike the outer surface of the enemy position. The problem was a difficult one to resolve, as to improve the range of the fuel it had to be of a thickness that could impede its effective burning.

The Americans experienced problems with the napalm composition throughout the war. Sometimes it separated in the tanks, resulting in the tanks not emptying completely. They developed alternatives, as did the British with their excellent thickener Fuel Research Aluminium Stearate (FRAS), which did not quite give the range of napalm, but delivered a more intense flame. Whatever the composition, thickened flame gave engineers and assault teams more control over the fire effects of flamethrowers.



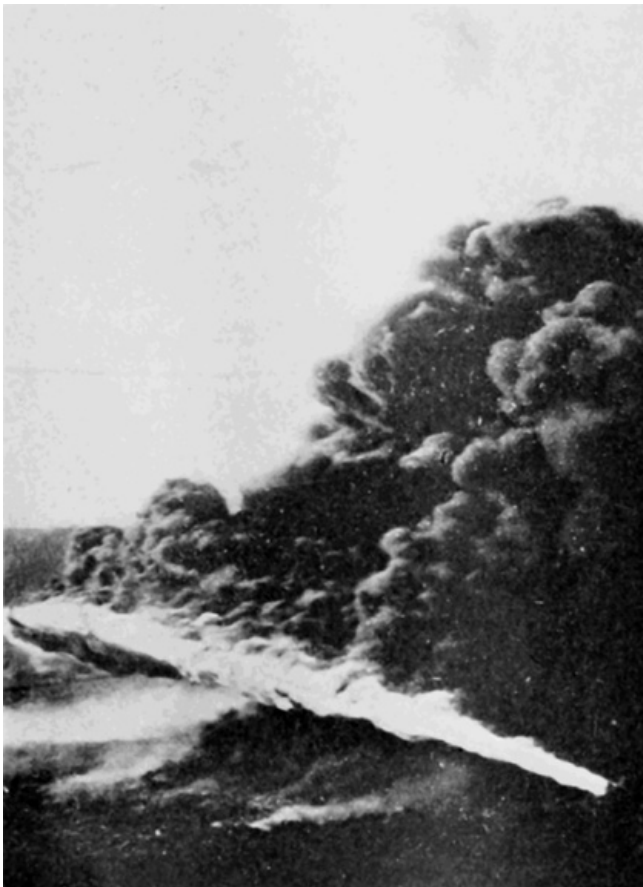
A *Flammenwerfer* opens fire; for a German flamethrower, the flame jet is relatively slim, indicating the use of a high-viscosity agent such as pitch or heavy fuel oil. (Nik Cornish at www.stavka.org.uk)

FLAMETHROWER TACTICS IN WORLD WAR I

The Central Powers

It was on the small scale, against tightly designated targets, that flamethrowers really came into their own. The Germans grasped this point early on, and their lead in flamethrower technology was also matched by a developing tactical organization of flamethrower units. At the beginning of the war, the *Pioniere* were the designated flamethrower operators. Platoon companies were specially selected for flamethrower duties, and issued with Kleif M.1912 weapons to two-man squads. Note, however, that there was some effort at broader tactical integration, the *Pionier* commanders liaising with their infantry counterparts over the best applications of the new firepower. By the autumn flamethrower units were being distributed on the basis of corps-level requirements, principally in support of major offensive actions. The first actual battlefield combat application of the German flamethrowers came about on 4–5 October 1914, during actions by 4. Kompanie, Posensches Pionier-Bataillon Nr. 29, against French troops around Bagatelle-Pavillon in the Argonne. The attack itself failed, but the flamethrowers showed enough promise that continued investment was made towards broadening their use on the battlefield. (Note that there is some evidence that flamethrowers were

A German static flamethrower, likely a Grof M.1912, sends out a huge defensive wand of flame over the battlefield; the flamethrower had a range of up to 40m. (*Popular Science Monthly*)



used earlier, in a less valorous context – the burning of the Belgian city of Louvain on 25 August.)

A major change in the status of the German flamethrower units came about in January 1915. In this month the German War Ministry authorized the formation of the first large-scale unit to be entirely equipped with flamethrowers. *Flammenwerfer-Abteilung Reddemann* (Flamethrower Detachment *Reddemann*) was set up under the command of the aforementioned Hauptmann Reddemann, and consisted at first of just 48 personnel. In a somewhat macabre career reversal, most of the personnel manning this detachment were actually former firefighters from the Posen Fire Brigade. Notably, after the detachment's first combat actions – at Malancourt on 26 February 1915 – its ranks had to be swelled under emergency by 22 infantrymen plus a former Leipzig Fire Brigade officer, to support an assault at Vauquois, Verdun.

The battlefield testing of the German flamethrowers was continually moulding tactical awareness of the new weapon. It was quickly realized that leaving a flamethrower team lumbering around on its own was tantamount to murder, and that it needed proper infantry support to provide the necessary suppressive fire for flamethrower-range engagements and to secure positions that had just been torched. Interestingly, the Germans also discovered that the flamethrower could have defensive applications as well. On 8 March, troops from the Kurhessisches Pionier-Bataillon Nr. 11 used Kleif M.1912s from trench positions against Russian attackers, at Rawa in Poland. With the flamethrowers proven in concept and battle, it was therefore time for expansion. In March 1915 Reddemann had his command upscaled to full battalion strength – III. Garde-Pionier-Bataillon, five companies strong: 9., 10., 11., 12. and Versuchs (Experimental) Kompagnien. Such was the special status of the battalion, with a strength of 800 men, that it was controlled directly by the Oberste Heeresleitung (OHL; Supreme Army Command), and Reddemann had to deliver detailed reports on each of its actions explaining all the various ‘lessons learned’ about the use of flamethrowers. In terms of the company composition, each company had three platoons, and each platoon fielded 4–6 of the large *Grof* flamethrowers and six of the smaller *Kleif* flamethrowers, giving the company a range of flame attack possibilities.

Further combat use of Reddemann’s specialists brought additional growth, particularly during 1916, the all-important year of Germany’s blood-soaked onslaught against Verdun. Prior to this, other forces within the German Army had experimented with using flamethrower troops as part of closely integrated assault squads known as *Sturmtruppen*. Wictor explains that ‘Assault squads were typically comprised of one to three infantry groups and one line-pioneer group armed with machine guns, trench mortars and the *Kleif M.1912*’ (Wictor 2010: 16). It is important to note that the flamethrower is not the centrepiece of this tactical arrangement, being the weapon with the shortest range, the least accuracy and the most vulnerable operators. Rather, the German experience showed that if the machine guns, grenades, rifles and mortar bombs of the infantry couldn’t scratch out a particularly obdurate position, the flamethrower could step in and do the job. By early February, the composition of the assault teams had become more sophisticated. A typical assault team at Verdun featured up to 20 infantrymen, conventionally armed with Gewehr 98 rifles and hand grenades (three each), plus a *Pionier* group armed with demolitions chargers and cutting/wrecking equipment, then a flamethrower squad with two *Kleif*

In this photo we get a clear sense of the weapons composition of a World War I German assault team. Multiple Wex flamethrowers are supported by grenade-throwing troops, an MG 08/15 light machine gun and the humble Gewehr 98 rifle. (Nik Cornish at www.stavka.org.uk)







Verdun, February 1916 (previous pages)

A two-man German flamethrower team, accompanied by assault troops from Sturm-Bataillon Nr. 5 (Rohr), makes an attack on a French trench line near Verdun. One man works the lance, directing the jet of flame along a French trench section, while his comrade carries the flamethrower bottle. Two other men, not visible here, would also serve the weapon – an assistant and a squad leader. The weapon is the Kleif M.1914 flamethrower, allied to a straight-nozzle lance. Lance heads were also available in angled versions, to deliver fire over trench parapets or around corners. The battle of Verdun saw particularly intense use of flamethrowers by German troops. Indeed, between 21 February and 27 April 1916, no fewer than 57 attacks were carried out by a force of ten flamethrower companies, who in total had some 400 flamethrower weapons. Tactical feedback from the actions led to the conclusion that 33 of the attacks had been successful. Good infantry support was critical to the outcome of the action; one of the assault troops is engaging fleeing French troops with his Gewehr 98 rifle, while the other prepares to throw a *Stielhandgranate* (stick grenade).

flamethrowers plus their own supply of grenades (high-explosive and incendiary). Together the assault team could tackle all manner of obstacles, the infantrymen shooting and bombing the team to close range (aided by the fire from MG 08/15 light machine guns), the *Pioniere* removing barbed wire and other obstacles and the flamethrower burning out defenders.

What was certain was that the flamethrower had become, by the time the battle of Verdun began on 21 February 1916, an integral rather than experimental component of the German arsenal. Indeed, III. Garde-Pionier-Bataillon swelled in size in February 1916, each field company expanding from 139 men to 200 men, and its allocation of flamethrowers rising from 18 to 54 (Wictor 2010: 18). On 20 April, III. and IV. Garde-Pionier-Bataillone were then merged into the prodigious Garde-Reserve Pionier-Regiment, 11 companies strong plus the support units. The regiment provided company-strength flamethrower support to various German corps, although the levels of demand for such troops meant that the companies were attenuated by constant losses across the battlefronts.

The flamethrowers of the Garde-Reserve Pionier-Regiment belched flame until the end of the war, finding just as much utility in the hands of assault squads during the offensives of 1918 as in those of 1916. Regimental records of the numbers of flame actions show that flamethrowers were used in 160 actions in 1916, rising to 165 in 1917 then 296 in 1918. The flamethrower had truly come of age. From mid-1915 it also acquired more of a body of officially written tactics, suited to the new battalion and regimental structures. In essence, the tactics were separated into two types – stationary and moving. Stationary attacks typically involved large flamethrowers being used to deliver what was in effect a short-range preparatory flame barrage against fixed positions, prior to an aggressive infantry assault to flush the

A demonstration of an Austro-Hungarian flamethrower c.1915; the flamethrower's nozzle is just visible to the right of the picture, and the weapon is probably the German Kleif M.1912. (Swiss Federal Archives)



stunned enemy out of his holes and bunkers. One interesting variation of this tactic was to dig tunnels to within firing range of the enemy trenches, and emplace *Grof* flamethrowers at the shaft face. When the moment of the attack came, the flamethrower operator would, apparently, emerge from the tunnel and blast the enemy by surprise.

Other applications of the flamethrower included flanking and pincer attacks made by flamethrower teams, supported by grenade throwers and machine guns to provide a suppressive fire. In the *indianermässigen Vorpirschen* (Indian-style forward stalking) tactic, the teams attacked the objective as dispersed individuals, varying the angles of attack to confuse the defenders. An unusual tactic was the *Messertaktik* (Knife Attack), here the flamethrowers attacked the enemy lines head on in sequence, punching through them with their flames while machine-gunners and riflemen followed up and fanned out, to guard the flame operators against flanking fire. There were also recommendations for *Tankbekämpfung* (Anti-Tank Warfare), showing how the flamethrower was being conceived as an additional solution to the Entente Powers' advantage in armoured warfare.

While Germany managed to forge a successful relationship with flamethrowers, such was not always the case with its allies. In the Austro-Hungarian Army, for example, the flamethrowers were principally operated by sappers, using German-provided weapons plus some home-grown variants. Like the Germans, the Austro-Hungarians recognized that the flamethrower operators were a breed unto their own, and concentrated such men early on into special sapper units, to be assigned to infantry regiments as required. However, the Austro-Hungarians, fighting primarily on the Isonzo Front, made some fundamental tactical errors in 1915, made worse by the unwieldy nature of the 50-litre M.15 flamethrowers they were using. By sending in flamethrower troops unilaterally on the attack, without a protective infantry shield, the Austro-Hungarian commanders ensured their men took heavy casualties, so many surviving flamethrower teams found themselves moved into static position roles.

Austrian troops in World War I prepare to fire a kleine 22l M.15 Flammenwerfer. The man standing behind the flamethrower team has a trench periscope to help guide aiming. (Nik Cornish at www.stavka.org.uk)



During 1916 the Austro-Hungarians consolidated their flamethrowers into specialist flamethrower platoons, generally employed alongside infantry as complete platoons. At the end of the year, however, flamethrower squads, in groups of three teams, were also attached to the new *Sturmpatrouillen* (Assault Patrols) and, from February 1917, the expanded *Armeesturmabteilungen* (Army Assault Battalions). Each assault battalion would include one flamethrower platoon with six man-portable flamethrowers, of the *kleine 15l M.16* variety. Those troops not assigned to assault battalions were absorbed into four (later six) flamethrower companies. Then in September, all these units were formed into *Spezial-Sappeur-Bataillon Nr. 61*, four companies strong, the companies then assigned individually to specific divisional assault battalions in 1918.

It appears clear that overall the Austro-Hungarians had a less than successful relationship with flamethrowers. Wictor comments:

It was soon clear [in 1917, during the battle of Caporetto] that infantry commanders did not know what to do with flamethrower platoons. Since flamethrower troops were sappers, they were often put to work in construction or improving trenches instead of engaging in combat, or they were marched to their assembly points with field tools, ordered to leave their flamethrowers in the rear. The few times that flamethrower platoons were used correctly, as at Rombon, the Brenta Dam, and Bonatto Ridge, they were most effective when paired with Assault Patrols of divisional assault battalions. (Wictor 2010: 45)

Wictor illustrates the key point that the Austro-Hungarians often failed to treat the flamethrower teams as the specialist troops that they were. Indeed, one key lesson about flamethrower troops of all nations and periods was that they had to receive appropriate and intensive training as part of assault units, if they were to perform with conviction on the battlefield.

The Entente Powers

As we saw in the previous chapter, the British were latecomers to the production of flame weapons. The weapons they did produce were either static monsters – such as the Livens Large Gallery Flame Projector or the Vincent flamethrower – or unconvincing ‘semi-portable’ versions. There were some large-scale applications of such weapons on the first day of the battle of the Somme, 1 July 1916. Four of the mighty Livens projectors were emplaced on the British front line ready for the attack, and at the attack hour on 1 July they each threw out mighty tongues of flame to ranges of nearly 100m over the German trenches. The projectors were traversed from left to right, to saturate long stretches of trench line, which were subsequently occupied relatively easily by the British troops. Yet how much the success of this advance was due to the flamethrowers, as opposed to the bludgeoning of shells and machine-gun bullets, is hard to say. One British critic, a Captain Sorensen, who participated in the battle, was sceptical about their value:

The large machines were fired on one or two occasions within the next few weeks, but it had become evident that their local effect did not justify the great labour and difficulty of bringing them within range of their objectives. [Special underground storage areas had to be dug for two of the projectors prior to the battle to prevent their detection by the enemy opposite.] Only on one future occasion at Dixmude [in Belgium] on October 27, 1917, was one of the large machines fired, and then only as a supplement to every other form of weapon fired. Indeed it was learned subsequently from prisoners that the flame-thrower had caused no casualties, the garrison of the 'Minotorie' [*sic*] against which it had been directed having already fled in terror. (Quoted in McKinney 1949: 10)

On one level, the Livens weapons do seem to have had some influence, in the sense that they helped suppress or evacuate German front-line opposition. Yet we must remember that the Germans practised defence in depth, with the front lines often being weakly occupied in comparison with the lines further back, from which an enemy offensive would be stopped and a counter-attack launched. In fact, we find very few examples that convince us of the British ability to understand the applications of flamethrowers in assault. Furthermore, the weapons that were designed often seemed to be as hazardous to their users as they were to the enemy they were fired at. During a test of a battery flamethrower at Wembley on 8 November 1916, for example, the device exploded, resulting in the deaths of two men and four wounded. Such destructive malfunctions were not uncommon, and at the front lines flamethrowers were often deposited in storage owing to the rusting and deterioration of their parts. This being said, some of the Livens projector oil-bomb barrages could be locally influential. On 1 October 1916, 36 drums of flammable liquid were fired at the German lines at Flers, 30 of them detonating on the German position, which was subsequently captured by an attack from New Zealand troops. A later official history described the effect:



An image of flamethrowers spraying across a Western Front battlefield in World War I. Flamethrowers could cause major land fires if used in an uncontrolled way. (Nik Cornish at www.stavka.org.uk)

When the trench was captured several groups, one of 20 and one of 15, of enemy dead were found badly scorched and charred by the oil flames. Some of the prisoners, as might have been expected, complained bitterly of the use of burning oil, and told of the terror excited by the fear of being caught in the flames. (Byrne 1921: 127)

Certainly the British never came anywhere near to the Germans' integration of flamethrower technology or tactics into infantry assault units. Britain's main flamethrower units were the four Special Sections that eventually comprised Z Special Company, No. 5 (Mortar) Battalion, a unit that largely remained experimental in outlook and practice.

One British tactical experiment that should be noted was, in 1918, the rather outlandish fitment of two Vincent battery flamethrowers to the Arrogant-class cruiser HMS *Vindictive*. The devices were fitted to 18 and 12 oil tanks respectively, with the jet nozzles placed in fore and aft armoured turrets. This fearsome naval system was tried out in earnest when *Vindictive* participated in the British raid on the port of Zeebrugge on 24 April 1918. Yet when both weapons were deployed, the only result was that uncontrolled gas pressure actually blew the flamethrower nozzles clean off, showering both fore and aft decks with gallons of flammable liquid. Thankfully, this liquid did not ignite.

The picture of flamethrower use among Britain's allies during World War I is more convincing, particularly among the Russians and the French. Like the British, the Russians really only got into their stride with flame weapons in 1916, but they better understood their value as tools of assault. Under the War Chemical Committee, formed in February 1916, then the Chemical Committee in the Main Artillery Administration, Russian flamethrower troops were equipped, trained and assigned in support of infantry operations. In April 1916, a Flame-Chemical Training Battalion was created, nearly 700 men strong, purely for the instruction in flamethrower tactics and weaponry, the product of this training assigned to 13 Chemical Detachments that were in turn assigned to army-level commands. Each detachment had three officers, 12 NCOs and 150 sappers, not only instructed in flamethrowers but also in gas warfare. Not until July 1916 were dedicated flamethrower detachments formed, each of one officer and 29 men, and armed with 12 portable flamethrowers, with one detachment being assigned per division.

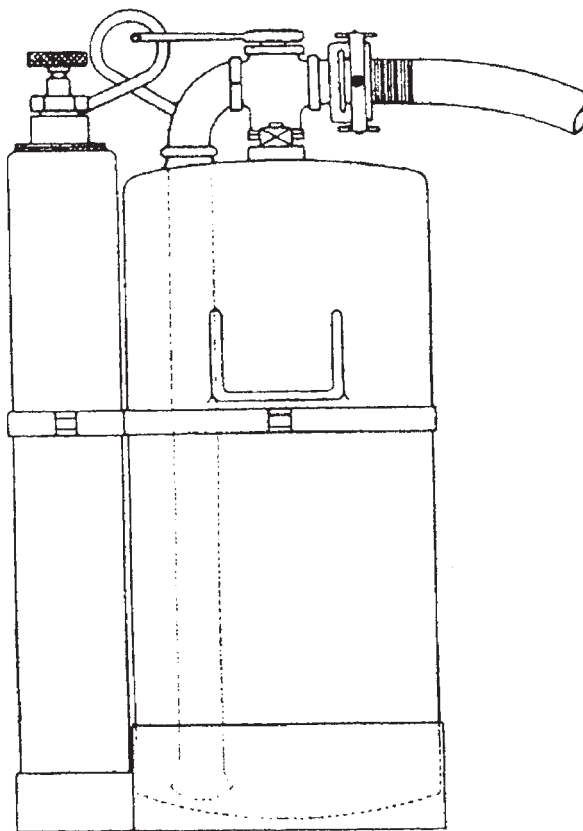
There were some differences of opinion among the Russian high command about the best way to apply flamethrower troops to combat. Some advocated their role mainly as defensive troops, doubtless influenced by the Russian purchase of British gallery flame projectors and associated training, while others felt that the offensive model was better. Eventually, both tactics were adopted, but the Russian Revolution in 1917 meant that there was little time to see whether the tactical decisions bore fruit. There were some combat outings for the Russian flamethrower detachments during the battles of June and July 1918, but the collapse in Russian organization and morale meant that these battles in general were failures for the Russians, and it is difficult to define the tactical lessons learned from such engagements.

The French were another matter entirely. In May 1915 they began establishing flamethrower companies among the sapper community, known as Schilt companies after the French flamethrower inventor, Capitaine Schilt. The companies were attached to engineer battalions as required, and each consisted of three officers and 115 other ranks. A *section hors rang* (non-combatant section) provided engineer, replacement and motor transport support, while three *sections de feu* (combatant sections) offered the active fighting component. Each of the three combat sections had a total of 12 flamethrowers. The tactical possibilities of flamethrowers expanded in 1917 with the introduction of the P weapons – no fewer than 40 of these highly portable devices could be put into action by a flamethrower company, with 30 more held in reserve.

As with other flamethrower forces, the French units had a fluid relationship with the rest of the army, being attached to infantry divisions as and when required. In terms of tactical deployment, the French were more focused on the integrations of flamethrowers into their wider assault tactics. For example, during an attack on 25 September 1915 (the first outing for the new Schilt No. 3 flamethrower), sappers attacked German lines in mixed assault teams, the flamethrowers being used to torch the German trenches and dug-outs, while the infantry then pushed through to take on further lines. Later, on 25 June 1917, French flamethrower teams were used to help clear a series of fortified underground cave structures (previously created by stone quarrying), known as the Dragon's Cave, at Hurtebise. The caves were impervious to shellfire, so the flamethrowers wiped out the German machine-gun nests protecting its approach and then torched the interior. The assault troops advanced closely behind the flamethrowers and successfully attacked the caves under the suppression provided by the flame weapons.

Taking into account other French actions, it is clear that the French Army had a far more modern and rational relationship to flamethrower tactics than the British. They were employed primarily against positions that were difficult to destroy by other means – deep trenches, dug-outs, pillboxes and bunkers, underground structures. Although the operators took their command from the officer of the infantry unit to which they were attached, there appears to have been a general awareness of the flamethrower's tactical possibilities and limitations, hence they were used only when survivability had been properly considered and a definite tactical purpose had been defined.

The Schilt No. 1 bis was an attempt to lighten the load of the original Schilt No. 1. It remained a powerful weapon, with a range of 35m and a burn duration of 20 seconds. (Courtesy of Thomas Victor)



The United States is an interesting counterpoint to the French, despite only joining World War I in 1917. In that year, there seem to have been two rather contradictory movements. On the one hand, the US Army was making investment in flamethrower troops – on 15 August, the War Office authorized the formation of the 30th Engineer Regiment (Gas and Flame), devoted entirely to gas and incendiary warfare. Yet the officer appointed to lead flame and gas operations in France, Lieutenant Colonel Amos A. Fries, noted in a report, even while testing European flamethrower types, that ‘the use of liquid fire or flame projectors is rapidly going out of date in all the armies. The labor, expense, and danger to the troops themselves using the apparatus are so great as to make other means of attack preferable in practically all cases’ (Fries 1917). The negative sentiments regarding flamethrowers expressed by Fries were reflected at many levels in the American Expeditionary Force (AEF) in 1917 and 1918. The US engineers intensively tested both French and British flamethrower types, rejecting many in the process, and tested some home-grown varieties. Yet flamethrowers underwent very limited combat testing, which is interesting given the heavy US utilization of flamethrowers in World War II. If anything, we see the Americans lean more towards French tactical models, which one day would have relevance to battles a long way away, on sun-bleached Pacific islands.

A French P3 flamethrower team at Cantigny, May 1918. The P3 was one of the smaller and lighter varieties of French man-portable flamethrowers used during the war. (Courtesy of Thomas Wictor)



FLAMETHROWER TACTICS IN WORLD WAR II

World War II was arguably the defining conflict in terms of the tactical development of the flamethrower. But although all combatants in World War II used flamethrowers, by far the most sophisticated operator was the United States, principally because of its unique experience fighting in the Pacific. World War II in some ways presented a far more dangerous environment for the flamethrower operator. Not only had armies absorbed the lessons learned from World War I, but manoeuvre warfare had become the norm, the days of static defensive combat starting to recede (with many exceptions, of course). Furthermore, improvements in every aspect of weapons technology meant that the battlefield had become terrifyingly lethal to anyone who couldn't move fast and low, a category that generally included flamethrower operators. The proliferation of automatic weapons such as submachine guns, light machine guns and (in some armies) automatic rifles meant that closing to flamethrower range was a truly dangerous business, requiring lots of friendly suppressive fire to ensure that the operators weren't shot to pieces before they got within distance. For this reason alone, a major trend of World War II was to see flamethrowers mounted in armoured vehicles. Not only did these vehicles enable far more powerful flamethrowers to be mounted, capable of engaging targets at reasonable stand-off distances of up to 100m, they also provided the protective armoured shell to shrug off the crackling clouds of bullets that now engulfed the battlefield.

Nevertheless, World War II also presented many new tactical environments for the man-portable flamethrower. Urban combat became far more common throughout almost all the theatres of war, and in the Pacific the jungle, mountain and island environments meant that much of the combat was conducted in close-range settings that required weapons to blast out emplaced defenders or cut through thick foliage. While, as we have seen, some authorities at the end of World War I were predicting the decline of the flamethrower in use, the demands of these environments kept the man-portable flamethrower very much alive.

A clear image of assault team co-operation. The two US infantrymen watch the flamethrower operator as he engages a target with his M2. Note the close proximity of the men to the target, which probably explains why the man on the right has his bayonet fixed. (Cody Images)



The Axis Powers

We have already seen how the Wehrmacht took into action a new wave of flamethrower types into World War II. The sheer numbers of flamethrowers produced also increased significantly throughout the war, indicative of the significance they accrued. Take the *Flammenwerfer 41* as a typical example. In 1942, the German armaments industry produced 4,618 of these weapons, but just the next year this figure jumped to 11,480. Then, in 1944, a total of 44,280 of the flamethrowers were manufactured. Essentially the flamethrower tends to be regarded as an offensive weapon, so why German production increased massively during Germany's most defensive years of the war is open to interpretation. Most likely is the upgraded quotas of flamethrowers were part and parcel of Hitler's attempt to arm his soldiery with weapons that acted as battlefield equalizers, shifting the weight of advantage back to harried Germans. As the war closed around the Reich, the Wehrmacht needed weapons that could have devastating effects against the legions of Allied armoured vehicles, and which could dominate in the urban warfare of heavily populated Western Europe. The *Panzerfaust* anti-tank weapon was another such equalizer, and it is no coincidence that Himmler's last-ditch force – the *Volkssturm* (People's Militia) – was equipped heavily with *Panzerfauste* and was also meant to be a major recipient of the disposable *Einstossflammenwerfer 46*, a disposable, one-shot flamethrower that emitted flame for half a second to distances of 40m. Production of this weapon went from 3,500 in November 1944 to 7,000 the next month.

Turning back to the Heer (the regular German Army) in World War II, however, how were its flamethrower units composed, and what was their tactical remit? As was typical, the flamethrowers were the province of the *Pioniere*. At the very beginning of the war, on 1 September 1939, the Heer had a total of 128 *Pionier-Abteilungen*, each providing divisional support. Within each battalion, the fourth company featured a flamethrower platoon, equipped with nine portable flamethrowers and manned by one officer, five NCOs and 12 soldiers who acted as flamethrower operators. The number of personnel available changed throughout the war, both officially and more significantly through the effects of manpower losses, but in general the actual divisional quota increased to around 20 flamethrowers.



Here we see a Romanian flamethrower team in action on the Eastern Front during September 1942. The flamethrower design seems to hark back to the Kleif M.1912, with its rigid lance. (Cody Images)

In April 1944, the US armed services published another of its *Intelligence Bulletin* works, which included an evaluation of German portable flamethrowers. It made the following observations:

Only the engineers carry and employ flame throwers. However, the engineers in the German army are regarded as combat troops, and engineer elements are frequently attached to small infantry units, down to the smallest assault detachments. These elements may be anything from an engineer platoon attached to an advance guard¹ to two engineers with a flame thrower supporting a raiding party.

Flame throwers are used only against static targets, preferably in inclosed [*sic*] spaces. They are used most of all against pillboxes. In such instances the flame-throwing detachment begins the final assault on the pillbox itself by engaging the embrasures at close range after infantry detachments have cut any communication wire. (The flame throwers usually advance to within effective range under cover of smoke or of fire from machine guns, antitank guns, or single tanks.)

The effect of the flame thrower is chiefly psychological. Moreover, the men carrying the equipment are good targets, once they have been spotted. Experience has shown that casualties in German flame thrower detachments are high. (US Military Intelligence 1944)

The footnote attached to this article noted that ‘for special missions the number of flame throwers may be increased’. This was indeed true, but the article was only partly correct in stating that *Pioniere* alone might be trained and equipped with flamethrowers. As the war went on, and became more threatening for the German homeland, regular infantrymen might also be trained up in the *Pionier* flamethrower roles. For example, a late-war *Panzergranadier-Regiment* (armoured infantry regiment) might have no fewer than 254 of its personnel retrained as a *Pionier-Kompanie*, with a complement of 24 flamethrowers. Meanwhile, a *Volksgranadier-Regiment* in 1945 would often have a *Pionier-Zug* (combat-engineer platoon) of 63 personnel and six flamethrowers.



The German flamethrower operator here has a *Flammenwerfer 41* model, easily recognized by its horizontal fuel and propellant tanks. (Cody Images)

The rest of the extract makes some useful tactical observations about German flamethrower usage. Certainly, the Germans utilized mixed-arms assault groups to reduce static positions, as was seen on the Western Front in 1939–40, most daringly during the attack on the Belgian fortress complex of Eben Emael on 10–11 May 1940. The US military made a more detailed study of how such attacks worked in its *Handbook of German Military Forces*, issued on 15 March 1945. It evaluated the composition and tactics of German assault detachments:

Assault detachments normally are composed of infantry with engineers attached. A typical assault detachment consists of the following: one officer; obstacle clearing party, consisting of two to six men for each lane to be cleared, equipped with small arms, wire-cutters, and bangalore torpedoes and other explosives; embrasure-blasting party consisting of three or four men equipped with grenades and demolition or pole charges. This party may also include, though it may work independently, a flame-thrower party, consisting normally of two men; covering parties, normally two or three parties of varying size from three men with one light machine gun to full platoons; smoke party consisting of two or three men equipped with smoke candles or grenades; supply party, carrying reserves of equipment and ammunition, their strength depending on the size of the assault detachment.

Attacks most often are made at dawn, and are preceded normally by heavy artillery preparation, one purpose of which is to make shell holes which afford cover for the advancing assault detachments as they move forward. When the latter reach the wire obstacles surrounding the enemy position, Very signals are fired, calling for available artillery fire to be brought on the position to seal it off from flanking positions. If, by reason of proximity of the assault detachment to the artillery's danger zone, the former cannot be protected by covering fire, the smoke party may lay a smoke screen. The obstacle-clearing party then cuts one or more lanes through the wire, using wire cutters or bangalore torpedoes. The embrasure-blasting party passes through and attacks the embrasures. Flame throwers, if employed, are not intended by themselves to cause the surrender of the position, but to cover the advance of the embrasure-blasting party with its explosive charges which are considered the decisive weapon. (US War Department March 1945: IV.17–18)

Flamethrowers were mounted on all manner of German military vehicles. Here a flamethrower is fired from an SdKfz 251/16, which was initially fitted with a single rear-mounted flamethrower, but later two flame projectors. (Nik Cornish at www.stavka.org.uk)



The description of this attack usefully shows how the German forces, like the Americans, integrated the flamethrower into a broader spectrum of weapons, to improve both survivability of all parties but also to offer a range of options for cracking open a dogged position. The presentation of flamethrowers as primarily cover weapons for the blasting team is not entirely accurate; flamethrowers could be position-destroying in themselves, but only if the flamethrower team was given the support to close right up to the position and inject flame through apertures (see the points made above about fuel consistency).

But the Germans also merged flamethrowers fully into their street-fighting tactics. Special assault teams of around ten men, armed with light automatic weapons, demolitions and one flamethrower squad, would be tasked with clearing particular buildings or underground structures, such as sections of sewer. For flushing out an enclosed space, the flamethrower could actually be more efficient than explosives – in many ways it was easier to take cover from a grenade than it was from an oxygen-eating sheet of flame. The main problem was keeping the flamethrower operator alive. In urban battles such as Stalingrad, for example, Soviet snipers were specifically tasked with targeting flamethrower soldiers. Using explosive rounds they could also nearly ensure a detonation of the fuel tanks strapped to the unfortunate operator's back.

Finnish troops engage a target near Leningrad in 1941/42. The flamethrower is the M/40, which was a Finnish designation of the Italian Lanciafiamme Spalleggiabile Mod. 35, purchased by the Finns in the early years of the war. (Nik Cornish at www.stavka.org.uk)



Russian flamethrower operator Sergeant Manakov, of the 145th Rifle Regiment, was reputed to have killed 50 Germans and destroyed seven gun emplacements with his weapon. (Courtesy of the Central Museum of the Armed Forces, Moscow via Stavka)



The Allied Powers

The Soviets and the British both employed flamethrowers during World War II, albeit in rather different ways. The Soviets invested heavily in flamethrower technologies – static, man-portable and vehicle-mounted. Its man-portable varieties were put to robust use in street fighting, assaults on Axis positions and also for anti-tank applications. In street fighting, Soviet flamethrower teams would establish interlocking fire over open areas and streets through which the Germans would have to pass. One German soldier stated that '[Soviet] Flamethrowers turn the entire killing ground that we have to cross into a sheet of flame' (quoted in Wijers 2008: 60). Like the Germans, the flamethrower crews would also work within small assault teams in urban combat, using small arms to suppress the enemy long enough to close with the flamethrowers. The flame

weapons would then blast a room, building or position, and demolitions teams would complete the job with satchel charges or grenades. When hunting tanks, the same assault teams would try to channel the vehicle into a narrow street, then blanket the tank's engine compartment with flame, or attack from above with large Molotov cocktails.

Flamethrower units (as of 1941) were typically embodied as a designated flamethrower platoon with a division's Chemical Defence Company. The platoon would consist of three flamethrower groups, each of 8–10 men, and included one truck driver (for

The Soviet soldier in the foreground here is armed with the ROKS-3, an uncamouflaged version of the ROKS-2 weapon. (Courtesy of the Central Museum of the Armed Forces, Moscow via Stavka)



transportation of all the heavy equipment), plus one man armed with a PPSH-41 or similar submachine gun to provide localized suppressive fire. The tables of organization and equipment (TO&E) became more flexible during the later, high-attrition years of the war, with light flamethrower companies attached to infantry formations on a needs basis.

Within the British Army, man-portable flamethrowers had a less pervasive existence. Partly this was because, after the traumas of the 1940 defeats, North Africa was for many years the British Army's principal theatre of operations. The open spaces here (meaning little cover for the flamethrower teams) and the relative lack of fixed positions to assault meant that the rationale for flamethrowers was weak, although they could be applied to anti-tank tactics. During the build-up to D-Day, however, it was recognized that flamethrowers, both man-portable and armoured, would have direct applications against German coastal and inland defences, so production and distribution was increased. The principal armoured flamethrower was the Churchill Crocodile, which could deliver 80 1-second flamethrower bursts to distances of 100m. At battalion level, the British forces also used the Wasp, a Universal Carrier equipped with a flamethrower. Yet on the smaller scale, more than 7,000 units of the Mk 2 'Lifebuoy' were also produced in 1943-44, many destined for France but others for the fighting in Italy, where flamethrowers also proved useful in assaulting entrenched German mountain positions.

In the ETO, the British flamethrowers found their *métier* in the ways we have already encountered in this book – position assaults, urban combat and anti-armour actions. Secret recordings of German POWs captured in Normandy in June 1944 record a special fear of the British flamethrowers. One officer, a Hauptmann Gundlach of 716. Infanterie-Division, spoke of defending a bunker near Ouistreham with tenacity until blasts from British flamethrowers resulted in many of his men passing out from heat exhaustion and oxygen depletion – he was quickly forced to surrender the position. During some of the advances across the waterways of Northern Europe, at times British and Canadian



A museum view of the ROKS-2 flamethrower. The feed system was a 9-litre fuel tank plus a single nitrogen pressure tank mounted below the 'backpack'. (MKFI)

This Polish freedom fighter in Warsaw in 1944 has a K-pattern flamethrower, which was specifically produced for the Home Army in Poland from 1942. It had a 15-litre fuel tank and separate compressed air bottle, and several hundred were produced. (Jerzy Beeger)



flamethrower teams were used to send protective arcs of flame across rivers while amphibious troops made crossings in small boats. Across the world in the jungles of Burma, the British also found the flamethrower useful, although here the terrain meant that armoured flamethrowers were rarely available, and the man-portable versions were paramount. Chindit columns, for example, featured a heavy-weapons platoon that incorporated a flamethrower. Several flamethrowers acting in unison were found to have a devastating effect on Japanese jungle positions and could also turn a Japanese-held village into a sea of flame if required.

The most intensive use of flamethrowers in World War II has to be in the hands of US soldiers in the Pacific, where flamethrowers became utterly integral to the tactics employed by both the US Army and the US Marine Corps. The process of finding a tactical role for the flamethrower, and assigning that role and carrying out the associated training throughout a huge and complex multiservice force, was a complex and frequently bloody one, of which a thorough summary is only possible here.

Encounters with Japanese and German flamethrowers made the US ordnance authorities aware of the weapon's true potential, and flamethrowers began to be issued to engineer units in earnest in 1942. Typical allocations of flamethrowers were 24 or 27 weapons per battalion (the higher figure was issued to parachute companies in airborne battalions). The first combat outing for the US flamethrowers was made in New Guinea in December 1942. The results were not promising. Not only had most engineers received inadequate tactical training for the new weapons, the adverse environmental conditions of the tropics caused numerous malfunctions in the flamethrower components. Better results, however, were obtained during combat on Guadalcanal, where it was found that flamethrowers were the ideal tool for the destruction of enemy bunkers and strongpoints, and the soldiers could receive more focused training. In a single day, 15 January 1943, USMC engineers managed to wipe out three tough enemy bunkers in just 20 minutes using flamethrowers. In one incident, it was noted that two Japanese troops dropped dead outside the torched bunker, without obvious major injury. This effect, it was discovered, was because the lethal effects of carbon monoxide poisoning could endure in the bloodstream for up to ten minutes after the attack, felling the enemy soldiers even when they thought they were safe.

Soviet flamethrower troops demonstrate the destructive firepower of a flamethrower, firing from a bunker position in what appears to be a training exercise. As the war progressed, the Soviets found the flamethrower especially useful for anti-armour actions. (Cody Images)



Gradually, the US authorities of the CWS woke up to the fact that infantry troops, not just engineers, needed to be trained in the flamethrowers to gain full benefit of the weapons system. By the end of 1943, the War Department took a mature decision in deleting portable flamethrowers from Tables of Basic Allowances for the Corps of Engineers, and instead allowing theatre commanders to decide on the levels of distribution and their tactical employment. Of course, there were dangers in this approach, particularly in ensuring that the levels of training matched the expectations for the flamethrower. Yet the experience of fighting the Japanese across the specific theatre was producing a sharpened tactical awareness among field commanders. Here is a passage of an after-action report, written by the chemical officer of the 41st Infantry Division following fighting on Biak Island, Papua, in 1944:

All commanders and leaders in the chain of command must understand the capabilities and limitations of the flame thrower before the effects of this weapon can be satisfactorily exploited. It must be emphasized that the flame thrower is not a weapon of opportunity but that it is a weapon to be employed why normal attack techniques using organic weapons, have failed. When employed, the flame thrower party must be supported in a carefully coordinated attack pattern, employing rifle, automatic weapons and mortar fixing fires which neutralise the fires of the enemy objective position and its supporting installations during the approach of the flame thrower group ... Such supplementary support would materially assist each flame thrower party to advance to a predetermined firing position within the range capabilities of the flame thrower. (HQ US Forces 1944)

The author of this passage recognizes that it is a disastrous tactical policy simply to have a flamethrower wavering about the battlefield waiting for targets to appear. Far better, both for the outcome of the action and the survivability of the team, for the flamethrower to be used only when a suitable target has been clearly defined and when the flamethrower is integrated into a 'carefully coordinated attack pattern', supported by a mixed-weapon assault team. Later in the report, more detail is given about the specific actions, with evaluations of these actions. Some examples are worth quoting in full. Here we see descriptions of two attacks against Japanese cave positions by soldiers of the 186th Infantry:

A US Army soldier fires what appears to be an M1 during an exercise at Fort Belvoir, Virginia, c.1941. At this stage the US forces weren't using thickened fuel, hence the billowing spread of this flame. (NARA)







Burma, March 1944 (previous pages)

Two Chindit operators, one wearing a Flamethrower, Portable, Mk 2, attack Japanese positions in Burma during the advance towards Lonkin in March 1944. The flamethrower operator is spraying flame up into a treeline, to flush out Japanese troops in the vegetation, while the other soldier levels his Thompson M1928 submachine gun in readiness to shoot down the enemy as they emerge. With a total weight of 29kg, the Mk 2 was a heavy burden for a soldier to carry around in jungle conditions. It was an improvement over the Mk 1 version, but in the tropical climate of Burma it was still prone to malfunction, especially in relation to its ignition system. Nevertheless, the searching effects of flame weapons did prove useful in jungle warfare, as it could strip away foliage cover and also push deep into the bunker and strongpoint systems the Japanese were so expert at constructing. As the Americans also discovered in the Pacific theatre, in many cases the purpose of the flamethrower was to drive the Japanese out of static positions and expose them to the small-arms fire of supporting infantry.

28 May – the 186th Infantry, reported that a flame thrower was employed against a cave occupied by two Japs. The cave was so deep and extensive that the flame thrower fire was ineffective.

29 May – 2d Battalion, 186th Infantry's operations against a Jap occupied cave north of Bosnek:

Detailed account: One of several caves along the shore line was occupied by an unknown number of enemy. Headquarters Company, 186th Infantry met heavy resistance from this cave. A flame thrower team accompanied by a rifle squad was assigned the mission of clearing this cave. On approaching this particular cave, the flame thrower team moved close under cover of the embankment to within twenty feet of the cave. Several members of the rifle squad deployed across the beach and covered the approach of the flame team. The flame thrower operator fired one burst into the cave. He then moved into a better position and emptied the contents of his flame thrower into the cave. Just after completion of the first delivery, a Jap appeared at the entrance and fired at the operator. The bullet penetrated the nitrogen cylinder of the flame thrower without injury to the operator. Three other Japs rushed out of the cave and were killed by our supporting riflemen.

Effectiveness: The exact effect of the flame thrower's fire other than causing the four Japs to emerge is unknown, since no attempt was made to enter the cave. However, no further enemy activity was observed from this cave.

Critique: This is an unusual incident. The tactics employed were satisfactory. The composition of the assault group was sufficient to permit it to close on the enemy position and accomplish its fire mission. There is some disagreement by the participants as to just what actually happened. Some claim that the Japs emerged from the objective cave,

while others insist that they appeared from the adjacent cave that had not been subjected to fire. Perhaps the exact details may never be known, but apparently the flame thrower's employment flushed the cave garrison so that they were killed by rifle fire and the position finally reduced. (HQ US Forces 1944)

The detailed account of the 29 May attack should not blind us to the short analysis of the 28 May action. Here the flamethrower attack fails because the Japanese defenders occupy a cave system extensive enough to permit them to escape the flame at the entrance, and also providing enough internal oxygen for them to keep breathing. What is interesting here is that the later flame attack on the cave didn't directly kill the cave occupants (or at least those we know about; we aren't aware of how many other individuals were occupying the position). Instead, the flushing-out effects of the flamethrower forced the four Japanese soldiers out into the open, where they were killed by other means. To achieve this outcome, and for the flamethrower team to get into the best firing position in the first place, required the diligent fire of a rifle team.

As the Americans battled their way across the Pacific, through the Philippines and across tortuous Japanese strongholds such as Tarawa, Iwo Jima and Okinawa, a pragmatic tactical realism regarding the flamethrower became more and more pervasive. McKinney explains what he sees as the key tactical parameters under which it became accepted:

Owing to the heavy weight of the flame thrower, its use was limited to either stabilized situations or to terrain where the equipment could be brought forward in vehicles or by native carriers. During the amphibious operations in the Pacific the Japanese were never able to seriously oppose a landing except on small islands such as Tarawa and Iwo Jima. This failure on the part of the enemy was primarily caused by the fact that he was rarely able to predict the landing beaches and the intense, murderous barrages laid down on the beaches by the Navy and Air Forces either destroyed the defenses or caused the defenders to withdraw. As a result, the flame thrower was rarely used extensively during landing operations. Each time the situation became stabilized and the attackers forced to advance against dug-in positions, the flame throwers came into use both in the assault and in mopping up. For example, one battalion commander reported after Iwo Jima that the portable flame thrower was the one indispensable infantry weapon. (McKinney 2010: 225)

A rare picture of US troops conducting beach assault training with a flamethrower in 1943. Note how the rest of the troops have to lie low to allow the flame to arch over their heads. (Cody Images)



The claim that the Japanese were 'never able to seriously oppose a landing' is open to question. Tarawa and Iwo Jima were horrific landings for the US forces, but there were other such examples, such as Peleliu and Saipan. The Okinawa landing was easier, but only because the Japanese island commander had made a deliberate decision to conduct the bulk of the battle further inland. During heavily contested beach landings, flamethrowers would have been next to useless, being both unwieldy at a moment when maximum movement was required, and also totally outranged by the fire raining down on the beachhead. Yet McKinney is right to point out that once the situation had 'stabilized', and the forces were faced with the (highly relative) predictability of reducing fixed positions or mopping up defined pockets of resistance, the flamethrower served the troops well.

It is interesting to compare after-action reports regarding flamethrowers from two widely separated actions, the battle for Tarawa in November 1943 and that for Iwo Jima in February–March 1945. The Tarawa report comes from the 2nd Marine Division, and among its lengthy passages it explains some key considerations about the use of flamethrowers in the hands of the engineers:

American troops on Okinawa take cover as a Sherman M4A3 unleashes its flame. The actual flamethrower unit is the M3 Auxiliary Flamethrower, which ejected 1 gallon (4.4 litres) of fuel every second. (Cody Images)

... the most important function of engineers in similar operations to Tarawa is demolition and flame throwers. It is recommended that engineer units carry more demolitions and flame throwers and that each LT [Landing Team – an amphibious assault unit] have such a unit available.





(2) Flame Throwers – Six flame throwers were employed by this LT in seizing assigned objectives. The combination tanks, flame throwers, and riflemen proved effective in destroying the enemy with minimum losses. Two flame thrower teams followed in close support of the tanks protected by a platoon of Infantry. The remaining four worked with the next rifle platoon in mopping up. When the leading platoon was held up, the next platoon with two of the four reserve flame thrower teams passed through and continued the attack.

Recommendations –

(2) Flame throwers – Additional flame throwers and teams (approximately 12 total) be assigned each LT. Sufficient supply personnel be part of the assault engineers to keep fuel and spare parts within 75 yards [68m] of the advancing troops at all times. Use of the flame throwers was limited due to the rapid expenditure of fuel and minor repairs needed. Spare parts and fuel were difficult to procure during all phases of the operation. (2nd Marine Division 1943)

A demonstration of the M1 flamethrower by the CWS, c.1942. The gas release valve is clearly visible on the back of the tanks. (NARA)

The report demonstrates a craving for more flamethrowers, such was their value during the assault across Tarawa. This desire was also extended to armour – the author of the report stated that he believed all light tanks should be converted to flamethrower vehicles, as the light tanks' main guns had little effect on the Japanese bunker positions. Note the sophistication of the flamethrower's integration with mixed-weapon assault teams, the flamethrower teams not only working with infantry but also with armour. By the time of the Iwo Jima operation, this process of

working together had been developed to a fine art, as this excerpt from a 21st Marines report illustrates:

The portable flame throwers used by this Bn were found to be highly effective against caves, bunkers, and pillboxes encountered during this operation. Normal employment consisted of moving the flame thrower operator into position from a flank, covering him meanwhile with rifle and BAR fire. Upon arrival within range of the target, the operator would shoot his flame across the cave or emplacement entrance or embrasure, and advancing quickly under cover of his own fire, place himself in position to direct his fire directly into the cave opening or embrasure. When so directed, flame thrower fire was consistently effective in silencing the cave or emplacement to the extent necessary to allow the placing of a demolitions charge. (21st Marines 1945)

This system of support fire, flame and demolitions worked in literally dozens of instances across Iwo Jima and later across Okinawa. Each aspect of the assault depended utterly on the other, the riflemen allowing the flamethrowers to get into range, and the flamethrowers permitting the demolition teams to get into range. One aspect that provoked some debate among the services, however, was whether the flame should be directed across the apertures of a position from the flank, or directly into the apertures from the front. The former had more of a psychological and suppressive effect on the position, while the latter was intended for pure destruction. In reality, the decision was dictated by the exigencies of the immediate combat situation, and especially the degree to which the terrain and enemy fire controlled the avenues of approach. Whatever the case, the flamethrower usually brought destruction to an enemy position. This being said, we must not imply that the flamethrower was the perfect weapon in the Pacific theatre, nor in any theatre for that matter. McKinney makes an important point about the US weapons:

Valuable as the flame thrower was when properly used, none of the models available during the war met the full requirements of the infantry. The logistics of the weapon hindered employment by foot-soldiers. It was too complicated and too fragile for combat use and required constant care and maintenance by experts in order to keep it in operation. Servicing and refilling was too involved, especially when non-pourable thickened fuel was used. Thickened fuel was too slow-burning to produce the required concentration of heat in a short time. The range was limited by the complicated high-pressure system used for propulsion. All of these limitations must be corrected if the weapon is to be exploited by the infantry. (McKinney 1949: 228)

During World War II, flamethrowers were indeed mechanically temperamental beasts, prone to malfunction and having poor resistance to the knocks, blows and dirt of the battlefield. All these factors would have a bearing on the status of the flamethrower in the post-war world.

IMPACT

A new world order

On 13 December 1989, eight soldiers of 1st Battalion, The King's Own Scottish Borderers (KOSB), were manning a permanent vehicle checkpoint complex at Derryard, near Rosslea in County Fermanagh, Northern Ireland. Vigilance in this highly contested part of the troubled province was the watchword, but little could have prepared the British troops for what was about to be unleashed against their small outpost. In the later part of the afternoon, an 11-man team of the Irish Republican Army (IRA), crouching in the back of an improvised armoured dumper truck, drove towards the outpost, intent on destroying it and the occupants.

Just after 1600hrs, the truck and its occupants drew up close to the checkpoint (other IRA members had secured the roads leading up to the outpost), and a British private, James Houston, approached the vehicle to do the customary check. At this moment, the IRA team triggered their attack. They opened up with blasts from assault rifles and threw grenades deep into the compound. Two RPG-7 rockets were fired at an observation sangar (a temporary fortified position). Yet most surprising, in its way, was that the IRA team also opened fire on the command sangar with a Libyan-supplied Soviet LPO-50 flamethrower. So big were the blasts of flame that a farmer reported seeing them rise from a distance hundreds of metres away.

The BMO-T is a Russian flamethrower personnel carrier. It is purposely intended to transport squads armed with RPO Shmel flamethrowers. (Vitaly V. Kuzmin)





During the Arab–Israeli wars of the late 1940s, the Israeli forces were often compelled to improvise. Here we see a fighter from the Irgun Zionist paramilitary organization with a crude homemade flamethrower. (Cody Images)

The IRA team prosecuted the attack with vigour, smashing the truck through the gates where they continued to let fly with small arms, grenades and the flamethrower. A second truck, laden with explosives, was also driven through the gates, but thankfully it did not explode fully. The British troops were forced to take cover and return intensive fire, and to their assistance came a section of Borderers troops from a nearby checkpoint, plus a Wessex helicopter. The attack was finally repulsed, the British suffering two dead and two wounded, while the Irish attackers escaped unscathed, to our knowledge.

The audacity of the attack sent shock waves through the British establishment and military community. The use of a flamethrower was particularly striking. This weapon, by 1989, seemed to belong to another era, the era of total war when it was acceptable to incinerate enemies with a naked flame. Nor was it the only incident in which the IRA deployed flamethrowers. Another attack on 12 November 1993 saw a converted manure spreader used to

douse a British Army watchtower in Crossmaglen, then ignite the fuel with a small explosive device. The result was a huge fireball that threatened to burn four Grenadier Guards alive; their salvation came from a Saxon armoured vehicle, which was able to cross through the flames to rescue the soldiers.

These two attacks do provide a salutary reminder that flamethrowers remain potent weapons. Yet in some ways, it feels that we are now living in a post-flamethrower age. Flamethrowers still sit in some military arsenals, and indeed they occasionally make a periodic appearance even in modern conflicts, seemingly reminding us of a more primitive way to make war. But there is no denying that the status of the flamethrower, and therefore its impact, underwent an inexorable change from 1945, declining in its authority and acceptability. As we shall see, there are those who think that the flamethrower's return is long overdue.

THE DECLINE OF THE FLAMETHROWER

Given the utility of the flamethrower in World War II, it was natural that it would continue to find applications during the conflicts of the first years of the Cold War. The first of these was the Korean War (1950–53), in which flamethrower tanks and man-portable weapons were used in the time-honoured fashion against North Korean and Chinese emplacements, particularly during some of the mountain clashes. There were some experiments in tactics. During Operation *House Burning I* and Operation

House Burning II on 26 October and 31 October 1951 respectively, US combat teams set out in helicopters to destroy dwellings they felt were being used by insurgents operating behind the United Nations line. Each attack involved four-man teams inside the helicopters, each team carrying a flamethrower, satchel charges and incendiary grenades. The helicopters would hover low over the houses, then the flamethrower team would soak the structures with unignited fuel. As the helicopter pulled away the fuel would be lit by one of the incendiary grenades.



The Korean conflict demonstrated that the flamethrower was still a practical device. Within ten years of its end, the United States was being drawn into another conflict in South East Asia, this time in Vietnam, and once again the flamethrower found its place. Vehicle-mounted flamethrowers – whether in Sheridan tanks or even fitted to riverine craft – provided the ultimate method of reconnaissance by fire, the laces of flame cutting through swathes of jungle and immolating jungle bases. For example, the M132 tracked flamethrower with an M10-8 flame gun was fitted to an ATC (Armored Troop Carrier) vessel in October 1967, giving birth to the first of the appropriately named ‘Zippo’ boats. For these boats, which could carry 200 gallons (757 litres) of fuel, the boatmen could send out a 32-second flame blast to ranges of 170m, giving them the ability to hit area and point targets well beyond the river’s edge.

American soldiers also carried man-portable versions such as the M2A1-7 and M9A1-7 into action on search-and-destroy missions. The flamethrower could blast through foliage, rooting out hidden Viet Cong or North Vietnamese Army (NVA) troops. There were few more efficient ways of torching a village or enemy encampment than blasting it for intense seconds with tongues of flame. Flamethrowers were also excellent tools for taking out Viet Cong tunnel systems. But the age-old dangers of being a flamethrower operator remained. One US platoon sergeant remembers the problem presented by an NVA-held hill, into which the enemy were heavily dug in. To deal with the problem, the unit received a resupply that included a

As Corsair fighters fly over, US troops demonstrate a broad mix of weapons in Korea, 1953. Supporting the M2A1 flamethrower are M1 Garand rifles, a Browning Automatic Rifle (BAR) and a Bazooka. (Department of Defense)

A US ‘Zippo’ patrol boat fires an arc of flame at the riverbank in Vietnam. Such weapons were very effective at striking out vegetation cover around areas of suspected insurgent activity. (Cody Images)





A US M67A1 flamethrower tank, a variant of the M48 Patton, fires into the Vietnamese jungle. Other US armoured flame vehicles in Vietnam included the M132, a variant of the M113 APC. (Cody Images)

number of flamethrowers. One man from every platoon was sent to camp to learn the techniques of using the flamethrowers, which were then sent forward when the hill was stormed on 27 November 1967. (Usually, flamethrowers in Vietnam were issued on the basis of two per battalion.) The platoon sergeant recalled that the man from his platoon armed with the flamethrower was killed when a piece of shrapnel hit the pressure tank, the concussion of the tank's depressurization killing the unfortunate user.

The Americans were not the only ones using flamethrowers during the Vietnam conflict. In return, the NVA also used flamethrowers – usually the Soviet LPO-50 – against the Americans and the Army of the Republic

Vietnam, 1971 (opposite)

A US Marine on a firebase in the highlands of South Vietnam fills up the fuel tanks of an M2A1-7 flamethrower from a 55-gallon drum. Nearby stands an M9A1-7 flamethrower, fully assembled, which the infantryman will be filling up next. The M2A1-7 was produced simply by the combination of the M2A1 tank group with the M7 wand. To fill the fuel tank, the operator first had to close the pressure tank valve and open the bleeder valve before removing the filler plugs. The tank could then be filled to within 5cm of the top of the tank before replacing the filler plugs. Behind the tank is also a cylinder of compressed air for recharging the pressure tank to a pressure between 1,700 and 2,100 psi. There were some hazards in this recharging process. The official US Army manual to the M2A1-7 noted 'To prevent eye injuries, vent the pressurized air from the air pressure system before attempting any maintenance or modification to the pressure system.' The M2A1-7 flamethrowers were progressively replaced by the M9A1-7, which was lighter and had a modified lance.



of Vietnam (ARVN). But Vietnam was the last major conflict in which Western powers significantly used flamethrowers against human targets. For times were changing. Television media was broadcasting to the world, on a nightly basis, the horrific realities of war, including the incineration of people and structures by air-dropped napalm. Napalm rose into the public consciousness like a demonic, fiery motif of all that was wrong with the war, and the flamethrowers also came to represent the most inhumane side of warfare, one that tolerated burning people to death. In 1978, therefore, the US Department of Defense issued a directive to its services stating that from henceforth flamethrowers would no longer be used on a tactical basis, and that further significant technical development would cease. This is why we have recently seen US troops in Afghanistan and Iraq using flamethrowers to burn away foliage or other obstacles, but not take such weapons into combat.

Political sensitivity is of course not the only reason why flamethrowers have largely ceased to appear on the menus of Western arsenals. The fact remains that these menus now include a formidable array of firepower not available to the companies, battalions and divisions of World War II. Man-portable missile weapons brought in a new world of precision fire and destructive penetration. The relatively humble RPG-7, for example, has an effective firing range of 200m and its shaped-charge high-explosive anti-tank (HEAT) round can penetrate up to 60cm of rolled homogenous armour, so can make messy work of an infantry bunker or pillbox as well. Its 105mm thermobaric warhead option produces a powerful blast effect that can kill every occupant of a strongpoint in one instant concussion. Furthermore, the RPG-7 is now rather outdated and crude. Modern US forces utilize the M74 Javelin, a guided fire-and-forget system that destroys armoured or protected targets at ranges of up to 4,750m, the missile making either top-attack or direct-attack profiles to ensure the destruction of the target.

Add to this picture the huge leaps made in the impact and control of air-dropped weaponry. Precision-guided munitions (PGMs) first started to make their impact felt during the Vietnam War, and were mainly used for the targeting of high-value strategic targets, such as bridges and powerplants. By the 1991 Gulf War, however, the laser-guided bombs were fine-tuning their accuracy. Riding laser beams locked onto the targets by ground troops or other aircraft, the PGMs were capable of flying through individual apertures in buildings or striking isolated and even moving vehicles. By the wars in Afghanistan and Iraq, GPS-guided bombs could basically strike whatever the ground troops required, by simple order through the command net. Fitted with delayed-action fuses and penetration warheads, those bombs could destroy even the most hardened positions. Rather than send a flamethrower team to make a perilous approach to within 30m of an enemy bunker, now a forward air controller could simply transmit the GPS co-ordinates of the target and wait safely at a distance of hundreds of metres, even several miles, for a bomb to obliterate the problem. Seen from this perspective, the flamethrower is indeed a dated weapon, a relic of the days when direct fire was king of the battlefield, and the enemy often had to be seen to be killed. But dig a little deeper and the picture is not quite as simple.

UP CLOSE

The latest US Army field manual relating to flame operations is FM 3-11.11, catchily titled *Flame, Riot Control Agent, and Herbicide Operations*. Published in 2003, it reveals a lot about the status of flame weapons in the modern US forces. A glance at the title page and the contents list, for example, shows that flame weapons and tactics at the infantry level are ranked alongside civil-disturbance control and vegetation removal – not exactly a resounding prioritization of flame actions. Yet at the same time, the manual fully recognizes the value of flame weapons on the battlefield:

Flame is a valuable close combat weapon that burns, depletes oxygen, and impacts psychologically. Since man fears flame, it is used to demoralize troops and reduce positions that have resisted other forms of attack. Flame produces the following effects:

Casualties. Casualties result from –

Burns. Thickened fuel sticks to clothing and skin, burns with intense heat, and is extremely difficult to extinguish.

Inhalation of flame, hot gases, and carbon monoxide.

Suffocation.

Shock.

Psychological. The psychological impact is probably one of the greatest effects of flame. In many cases, defending personnel will leave well-prepared positions and risk exposure to other weapons or capture. In other cases, the enemy is forced to withdraw from firing positions during the effective period of the flame attack. This permits friendly forces to close in before the enemy reoccupies his firing positions.

Splatter. Flame reaches around corners through the splattering and ricochet action of the thickened fuel on adjacent surfaces. The splattering action of the thickened fuel spreads the flame over an area—in contrast to the point effects of nonfragmenting small arms ammunition.

Incendiary. Flame ignites combustible materials to cause additional problems for personnel. Flame weapons ignite clothing, tentage, wires, petroleum products, buildings of light construction, light vegetation, munitions, and other combustible material. (Department of the Army 2003: 2-1)

The list of recommendations here is extensive. All of these we saw in

A US Marine near Da Nang, Vietnam, clears an area with a blast from an M2A1-7 flamethrower. The M7 gun had no front grip like the M2 gun. (Cody Images)



evidence during two world wars, in which major bunker complexes were silenced with several blasts of flame. There is a section in the manual devoted to explaining the principles and practices of using the M202A1 Flash rocket launcher and also covering incendiary grenades, but nothing relating to the use of man-portable flamethrowers as we have known them. In fact, the manual's silence regarding flamethrowers is deafening. The actual word 'flamethrower' is mentioned just once, in the following context: 'The use of weapons that employ fire, such as tracer ammunition, flamethrowers, napalm, and other incendiary agents, against targets requiring their use is not a violation of international law. They should not, however, be employed to cause unnecessary suffering to individuals' (Department of the Army 2003: 2-1). This simple paragraph has profound ramifications. Flamethrowers, which are still in US arsenals, are accepted as legal weaponry under the stipulations of international law, alongside staples such as tracer ammunition. But the last sentence turns things around. If ever there was to be a weapon that might be deemed as causing 'unnecessary suffering to individuals', it would be the flamethrower. The psychological and physical damage caused to soldiers by flamethrowers makes them publicly unacceptable in the modern age. A thesis submitted by Captain N.T. Perkkio, USMC, in February 2005, tellingly entitled 'Bring on the Flamethrower', makes further reflections on this very issue and on the flamethrower's legality:

The use of incendiary weapons, like the flamethrower are not banned by the generally accepted rules of warfare. According to the Protocol on Prohibitions or Restrictions on the Use of Incendiary Weapons (Protocol III) 'it is prohibited in all circumstances to make the civilian population as such, individual civilians or civilian objects the object of attack by incendiary weapons.'¹² Therefore, it is not a violation of international law to use flamethrowers against military objectives such as terrorists or insurgents. However, the ethical argument is that the flamethrower is non-discriminatory in nature. Since its use in Vietnam, the flamethrower has fostered an image for inflicting tremendous suffering, like that of the young screaming girl running naked down the road. Such casualties, civilian or military would require extremely

expensive medical treatments. As Machiavelli said, 'Does the means, justify the ends?', a question that many moral leaders have debated over since the introduction of the flamethrower. Yet, solid training ... would aid in overcoming the nondiscriminatory nature of the flamethrower. (Perkkio 2005: 10)

Perkkio's point, developed systematically throughout his thesis, is that the flamethrower has, in many ways, developed an aura of illegality

US soldiers test out a flamethrower on a most unusual set of targets on a range in June 1977. This long perspective shot gives a good impression of the range capabilities of the man-portable flamethrower. (Cody Images)



that is not justified in terms of international law and which also detracts from the utility of flamethrowers as actual combat weapons. Were a new generation given proper tactical training in the flamethrower, then this weapon might experience a resurgence in combat use.

Nor is Perkkio's an isolated voice. In Afghanistan in particular, Coalition forces found that some of the Taliban's mountainous hideaways or deep bunkers were resistant even to the most probing bomb and rocket weaponry. Some authorities argued that having a flamethrower ready to go would have made the reduction of such positions much less problematic. In January 2012, author Charles A. Krohn (a former US Army lieutenant colonel) wrote an article for the online *Small Wars Journal* entitled 'Thinking the Unthinkable about Napalm and Flamethrowers'. Krohn argues that despite the introduction of effective thermobaric weapons, flamethrowers can still have a role to play on the battlefield:

The great advantage of a flame weapon such as napalm delivered by flamethrower is that it sucks the air out of the cave, without exposing friendly forces to gunshot or IEDs. And it scares the hell out of anyone watching, thinking they may be the next target.

The solution may sound simple but there is no flame weapon in the Army's arsenal, to the best of my knowledge, as there was when I was a young officer in Southeast Asia. Many years later, while serving in the Pentagon as we invaded Afghanistan and Iraq, I inquired if we still have flamethrowers in storage. While some friendly nations still manufacture and deploy them, I learned, the only similar weapon in the Army arsenal was a shoulder-fired missile called 'Flash'. It wasn't clear if launchers were still around or how many missiles were in storage that were safe to fire. In any event, there was no apparent training program to teach soldiers how to use the weapon. (Krohn 2012)

Krohn raises a question mark over the lack of access to flamethrowers by US troops, and the lack of training relating to the M202A1. Indeed, the M202A1 appears to be little-used in combat. The point raised by Krohn and several other commentators is that there is a decent tactical argument for having flamethrowers in the active arsenal of modern armies, and individuals trained and ready to use them.

This author agrees. Note what I am *not* saying. I fully recognize the limitations and dangers of flamethrowers. In the vast

US Army troops in Iraq, 2008, sit behind a tank of flammable liquid, which was intended for use in flamethrower brush-clearing operations. (US Govt)



majority of cases, when faced with a defended bunker, a soldier would be far better to attack it with, say, a thermobaric warhead fired from a shoulder-launched multipurpose assault weapon (SMAW) from 250m away than attempt to close within 30m to deploy a flame weapon. In the vast majority of cases, the rocket will do the job. Nor am I shying away from the horror of flamethrowers – no sane person would wish to see human beings torched to death. Yet there remains the fact that flamethrowers are very good at tackling a certain type of target when all other methods have failed. This was, in a nutshell, the greatest impact of the flamethrower in two world wars and in some post-1945 conflicts. Regarding the horrors, I find it hard to quibble over grades of violent death. Even someone shot with a single standard 5.56mm ball round can experience a ghastly death, involving terrible pain and massive injury. A useful final word on this issue comes from Perkkio, who observes that flamethrowers have been used quite recently in warfare, by the Russians in Chechnya:

Most recently, the Russians employed flamethrowers against Chechen rebel forces during the Battle of Grozny. According to Vladimir Berzko's article, 'Flame Throwers: A Second Birth,' flamethrowers appeared to be the weapon of choice for the Russian forces. They found the Shmel flamethrower to be a force multiplier for combat in the urban environment. In interviews with Russian forces, Berzko further concluded that the flamethrower was chosen as much for its psychological effect as its ability to flush insurgents or snipers out of enclosed fortified positions. One particular lesson learned from employing flamethrowers in Grozny, was that they were underutilized. Deemed a military blunder, Russian forces improved their training and knowledge for effectively employing the flamethrower in an asymmetrical environment. Although considered a blunder, it is quite plausible, that the knowledge and experience of flame weaponry disappeared with the Red Army during the collapse of the Soviet Union. As a result, Russian troops were initially under trained for the Battle of Grozny. Hopefully the U.S. military and its leaders will recognize the

value of the flamethrower in an asymmetrical environment as the Russians did in the Battle of Grozny. (Perkkio 2005: 5)

Perkkio notes that in a Russian context the flamethrower is experiencing 'a second birth', a new life in the context of asymmetrical urban warfare. Countries such as China are also investing in their flamethrower training, even as they attempt to bring their armed forces into the modern information age. Perhaps the full impact of the flamethrower is yet to come.

This striking image shows a US Navy patrol boat deploying a flamethrower off the coast of Vietnam in 1969. Flamethrowers proved ideal maritime weapons for littoral and riverine operations. (US Govt)





CONCLUSION

The life of the flamethrower operator was not, generally speaking, a happy one. Flamethrower crews needed nerves of steel to approach to within pistol range of the enemy positions. The enemy within, often fully cognizant of the threat attempting to manoeuvre upon them, would largely be equipped with rifles, machine guns and submachine guns, all of which significantly outranged the flamethrower. A typical portable flamethrower has a range of around 30m, depending on fuel type and weather conditions, whereas machine guns would be able to cast a lethal arc around a position extending to around 600m for direct observed fire and more than double that range for indirect dropping fire. Closing to firing range with a flamethrower meant that you had to place yourself within just metres of an alert and resistant enemy, and do so with a conspicuous tank on your back. (One myth about the flamethrower is that it was liable to explode if the fuel tank was struck by a bullet. In fact, ignition rarely took place in such circumstances if the round was a solid ball round, and instead the fuel would simply leak out – the situation would naturally change if the fuel was hit by a tracer or exploding round. Far more dangerous was a hit on a propellant tank, the explosion of the pressurized container causing blunt injuries.)

Another consideration of being a flamethrower operator was that the bulk and complexity of your primary weapon largely prevented you from carrying or

Where it all began. German *Pioniere* conduct flamethrower training on a range in Sedan, France, prior to heading off for the front line. Flamethrower personnel have always needed thorough specialist training to operate their weapons properly. (Cody Images)



operating other types of weapon as back-up. A pistol in a holster would offer some means of personal defence, but to most intents and purposes the lives of the flamethrower team would rest in the hands of the infantry around them. This situation demanded absolute trust. Remember that the short range of the flamethrower meant that if you did flush out enemy troops from a position, they would be literally flooding around you. If the support troops didn't suppress, kill or capture them quickly, odds were that you would quickly become the victim of those you attacked. It was nerve-shredding stuff.

As a brutal example of the flamethrower experience, during the battle for Luzon on 24 February 1945, a US assault team was fighting bitterly to reduce a Japanese position dug into Hill 2500, north-west of Kitakita. The objective was a large cave near the hill summit, the entrance to the cave protected by a huge boulder that rendered much small-arms fire ineffective. A flamethrower team was sent in and the operator fired fully 12 bursts into the cave entrance. With rapid effect, no fewer than 26 Japanese soldiers were flushed out into the open. Only one of them was on fire; the rest were resolutely alive and swarming around the flamethrower team's position. With murderous discipline, the US infantry support rapidly picked off all the enemy troops, except one, who was killed by the flamethrower operator using his flamethrower gun as a club to break the man's neck.

For the reasons outlined above, it was sometimes difficult to find taciturn men willing to serve as flamethrower crews. Life expectancy could be short, and such was the unpopularity of flamethrower operators that, like snipers, if captured they would in most cases be executed out of hand. Much of the focus of this book has been on the flamethrower's effect on target, and the tactical case for their deployment. However, regardless of the technology or tactics, it still took a brave man to strap heavy, bulky tanks of fuel and gas onto his back and step out into the line of fire.

Although flamethrowers are generally associated with the darker side of warfare, they have also been the tools of freedom fighters. Here we see Polish insurgents with indigenous flamethrowers in Warsaw, 1944. In return, the Germans used flamethrowers to burn down large areas of the city. (Republic of Poland)



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Members of a German flamethrower platoon on a training exercise, probably around the beginning of World War II. They wear thick engineer overalls to protect them from the heat of their weapons. (Nik Cornish at www.stavka.org.uk)

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Editor's note

For ease of comparison please refer to the following conversion table:

1km = 0.62 miles
1m = 1.09yd
1m = 3.28ft
1m = 39.37in
1cm = 0.39in
1mm = 0.04in
1kg = 2.20lb

Cover photographs. Above: a Lanciafiamme Spalleggiabile Mod.35 flamethrower (Public Domain). Below: a flamethrower in action in Vietnam in March 1967 (Cody Images).

Title-page photograph: German assault troops undergo an exercise with a Wechselapparat (Wex) M.1917, one of the late-World War I portable flamethrowers. Here the lance operator is separate from the tank carrier. (Nik Cornish at www.stavka.org.uk)

Artist's note

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